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safe
extremely tough
and durable
non-toxic
no fire risks
unlimited colours

Courtaulds Technical Service welcomes your enquiries about any aspect of plastics.

This doll may not look it — but she's as tough as nails: because she's made of Courtaulds cellulose acetate. She won't break in transit — probably never break at all — and *can't* break with a jagged, cutting edge.

Courtaulds Limited
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R v.19' Ja-De '54

injection moulders please note

BEXTRENE Regd.

polystyrene moulding powder

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REGENTONE "MULTI 99" RADIOGRAM

ESCUTCHEON AND GRAM FRONT
in Cream Polystyrene

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FERGUSON "351" RADIO

HANDLE and KNOBS in Cream and Pastel Shades of Polystyrene.
SCALE in Amber and Crystal Clear Polystyrene.
WAVEBAND blocked in two or three colours.

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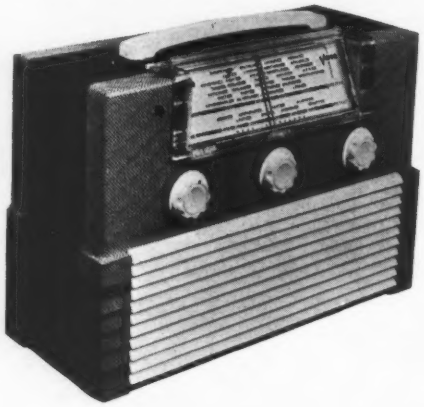

VIDOR "GALA" PORTABLE

WAVEBAND WINDOW in Crystal Clear Polystyrene.
KNOBS — HANDLE — LOUVRE
in Cream Polystyrene.

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the finest stokers I've met—and that's saying something after 30 years. You get better burning even from the poor stuff you get nowadays. It's easier to fire too, and mechanically these Bennis Stokers are a grand job—never have any trouble at all.

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Bennis are designers and manufacturers of a full range of Mechanical Stokers to suit most types of Boilers, and are, therefore, able to do what no other manufacturer in this Country can do, that is install the correct machine to meet the conditions and requirements prevailing in each individual plant.

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P2968

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British Jet wins New Zealand Air Race

in the speed section

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BATTERY MOULDINGS

Material used was Distrene 500 Natural, made by British Resin Products Ltd.

Flt.-Lt. Roland Burton—winner of the speed section of the London to New Zealand air race, inspecting the Oldham batteries on his Canberra just before take-off time.

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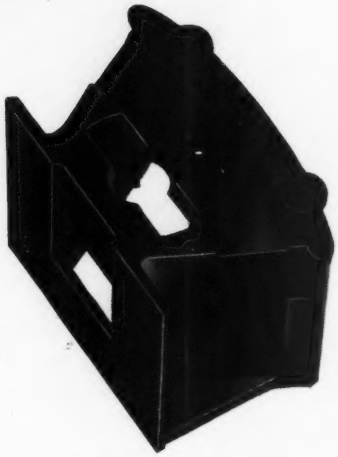
the case of the BROWNIE 127

No need to hear this *in camera*. It's no secret. A compression and injection job, it called, if we may say so, for superb accuracy and finish, particularly as it was wanted for a Kodak camera. There was the case 'body', the cover to fit the case and various internal parts, all of which were precision-moulded to narrow limits.

VERDICT — just another example of the work of an expert tooling and moulding service.

Can we help you, too?

TECHNICALLY, a high degree of accuracy was achieved to ensure that the cover fitted the case perfectly. Both cover and case were compression-moulded in black wood-filled Phenolic material giving a black lustrous finish. The case body was produced on three 2-impression side ram tools to simplify moulding complicated by innumerable undercuts. Various internal parts of the camera were injection moulded.

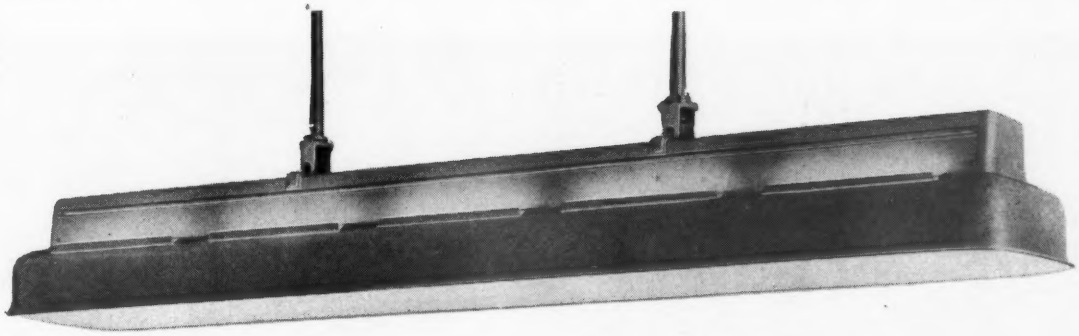


EKCO plastics for industry

Write for a copy of the new Ekco Standard Mouldings catalogue

E. K. COLE LTD. (PLASTICS DIVISION), SOUTHEND-ON-SEA, ESSEX

(Members of the British Plastics Federation)



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There is a wide range of specially designed G.E.C. fluorescent fittings for every trade and industry. Simple to fit. Snap-action dismantling for quick, easy one-man maintenance. Consult your local contractor for best type of G.E.C. fitting . . . with of course Osram tubes.

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● *The General Electric Co Ltd, Magnet House, Kingsway, London WC2*

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Tailored for the job

The lighting of many processes is vital to the smooth and rapid flow of work and to the quality of the finished product. For example, poor lighting could make a spray tunnel into a bottle-neck — each job taking a little too long, a little portion missed, a return to the spray line — and so the whole production line marks time. Whatever form it takes, good lighting not only helps to provide a satisfactory working environment but is an active production tool.

Fluorescent lighting is as good as daylight — only more consistent. It is efficient; it is economical; and it is *flexible*. You can ' tailor ' it, easily and exactly, to the special requirements of production at all stages.

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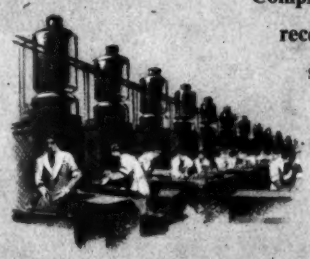
Electricity for PRODUCTIVITY

Issued by the British Electrical Development Association

CMS

plas
mould



CMS offer a moulding service with many advantages. Completely equipped and experienced to get to work on receipt of your drawings, we can assure you on-time supplies of perfect mouldings, identical in strength, composition and accuracy and our modern methods bring down costs to a minimum. Why not send us your next job?

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Cogent

B

Photo by Courtesy of The Lawrence Process Co. Inc., U.S.A.

Compounding, Colouring and Extruding of Elastomeric Vinyls at a Single Operation

Simplicity, economy and quality are conspicuous in the Windsor Extruders operating at The Lawrence Process Company, Inc., Lawrence, Mass. Each of two Windsor Model R.C.100 twin-screw Extruders is producing plastic shoe-welting at the rate of 125 lb. or more per hour within tolerances of .002". "Our Windsor Extruders have so completely justified our expectations that they seem almost as if they were custom-tailored to our particular needs," states E. F. Hogan, President of Lawrence Process. "We find the twin-screw Extruder gives us a remarkable degree of dimensional stability."

Compounding, Colouring and Extruding are all done at a single pass at Lawrence Process.

Pre-blended plasticized PVC or elastomeric vinyl is used; modest in-plant pre-blending equipment saves the firm from 4 to 6 cents a lb. in the preparation of the material—and only three men do all this work on two machines!
Use of Windsor twin-screw Extruders has helped Lawrence Process to streamline its production. All inspection, gauging, reeling and packing of the finished product is done at the wind-up end of each Extruder. The firm plans to double its present extruding capacity within the next few months.

Sections of Plastic Shoe-Welting made on Windsor R.C.100 Extruders at The Lawrence Process Works.

Leaflet with full Specification sent on request.

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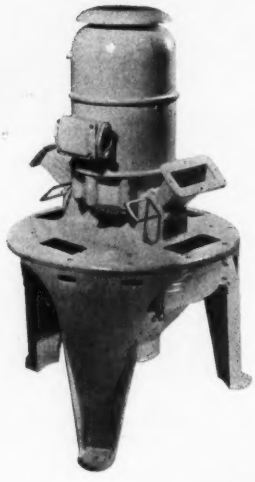
C

MIX IT WITH THE ENTOLETER

Whatever the mixture you require, there is almost certainly an Entoleter to produce a uniform and intimate blend which is beyond the scope of conventional mixers. Recent successful applications include the blending of:— Moulding compound for gramophone records · Filled phenolic compound for the manufacture of plastic dishes · Filled vinyl moulding compound for the manufacture of storage battery cases, etc. The Entoleter can produce a finished mixture at rates of up to 200 lb./minute, and is easily incorporated as a final mixer in existing processing systems to cut mixing time, reduce costs and improve product quality. Send for leaflet IP1 describing this machine.



Entoleter Centrifugal Machines DISTRIBUTED BY *Henry Simon Ltd* SIMON ENGINEERING GROUP

H.S.127

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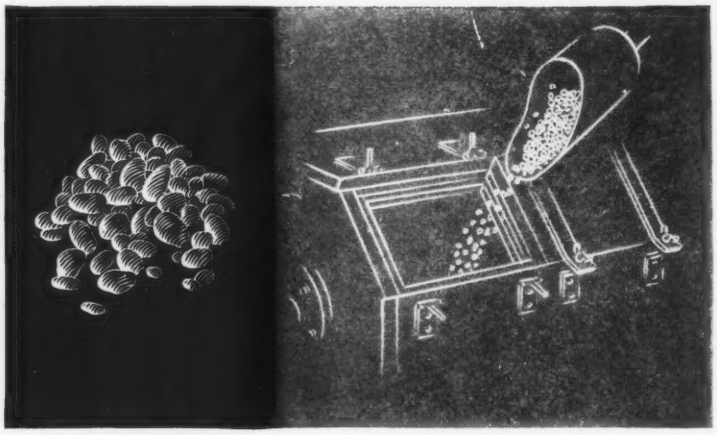
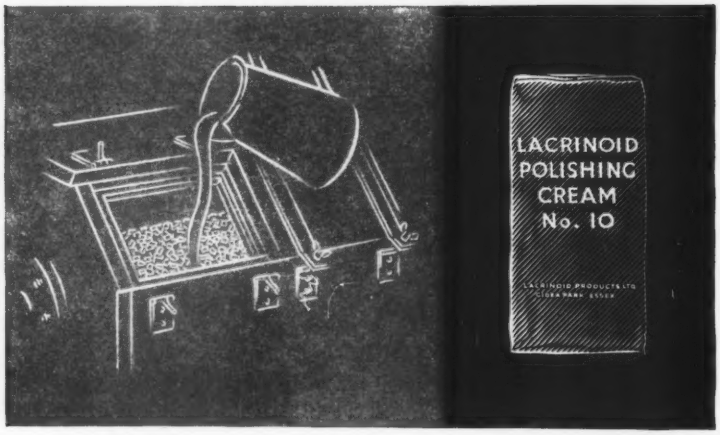
Ensure a finer finish - - faster

FINISHING GRANULES
for the barrel surfacing of plastics and wooden parts. The granules are of porous stone impregnated with a special bonding and lubricating compound. Their use prevents formation of dust and protects the material from abrasions. The granules can be reimpregnated after a period of use.





POLISHING CREAM No. 10
for the barrel polishing of small and medium sized plastics objects. A lasting, brilliant lustre is imparted with great speed and with the very minimum of supervision.

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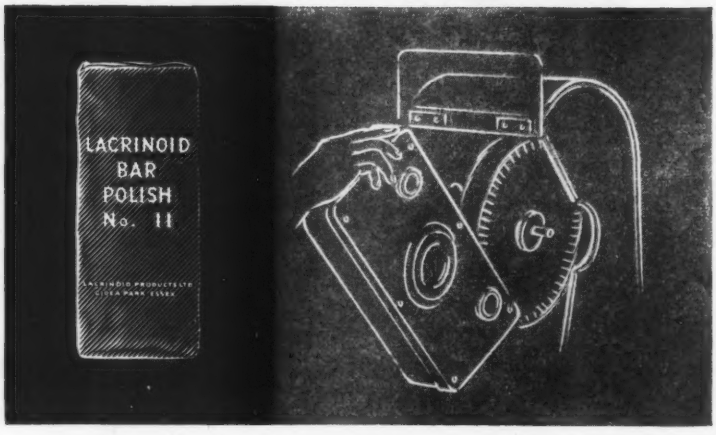
performs simultaneously the functions of (1) abrasion, (2) finishing and (3) glossing. It is fast in action and not only saves time but results in considerable economies in the replacement cost of mops.

Apply for descriptive leaflets which give fuller details of above materials.

The services of the Lacrinoid Research Department are freely offered in any development of finishing and polishing techniques.



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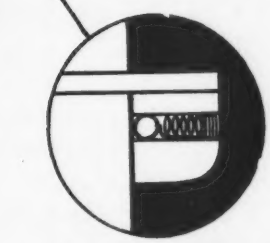
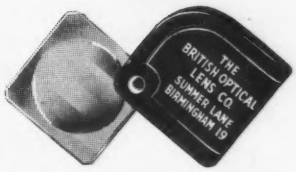
LACRINOID PRODUCTS LTD., GIDEA PARK WORKS, STAFFORD AVENUE, GIDEA PARK, ESSEX. Tel: Hornchurch 2981

FOCUS on an OPTICAL PROBLEM

Attention is drawn to the simple but effective ball and screw focusing mechanism.

Manufacturers and designers frequently ask us to help them cut down production expenses through the wider use of plastic mouldings. The lens system illustrated is a typical example. Required for use in a film strip projector it would normally be made of metal—a job requiring highly skilled precision engineering. We evolved a special moulding technique and by using a phenolic material which had the advantages of a smooth block finish, produced the lens mount shown. We also designed the focusing system and our associate Company* produced the lenses.





* Our Associate Company, The British Optical Lens Co. is one of the largest producers of precision lenses for optical instruments of every type ranging from the simple pocket glass shown above to highly complicated condenser lens systems.

Our advisory service is at the disposal of all designers and manufacturers.

THE BRITISH OPTICAL LENS CO.
in associate with
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Some of the Machines in our Injection Moulding Works at Summer Lane.

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Our Technical Sales Department will be pleased to advise you on your special needs

V32

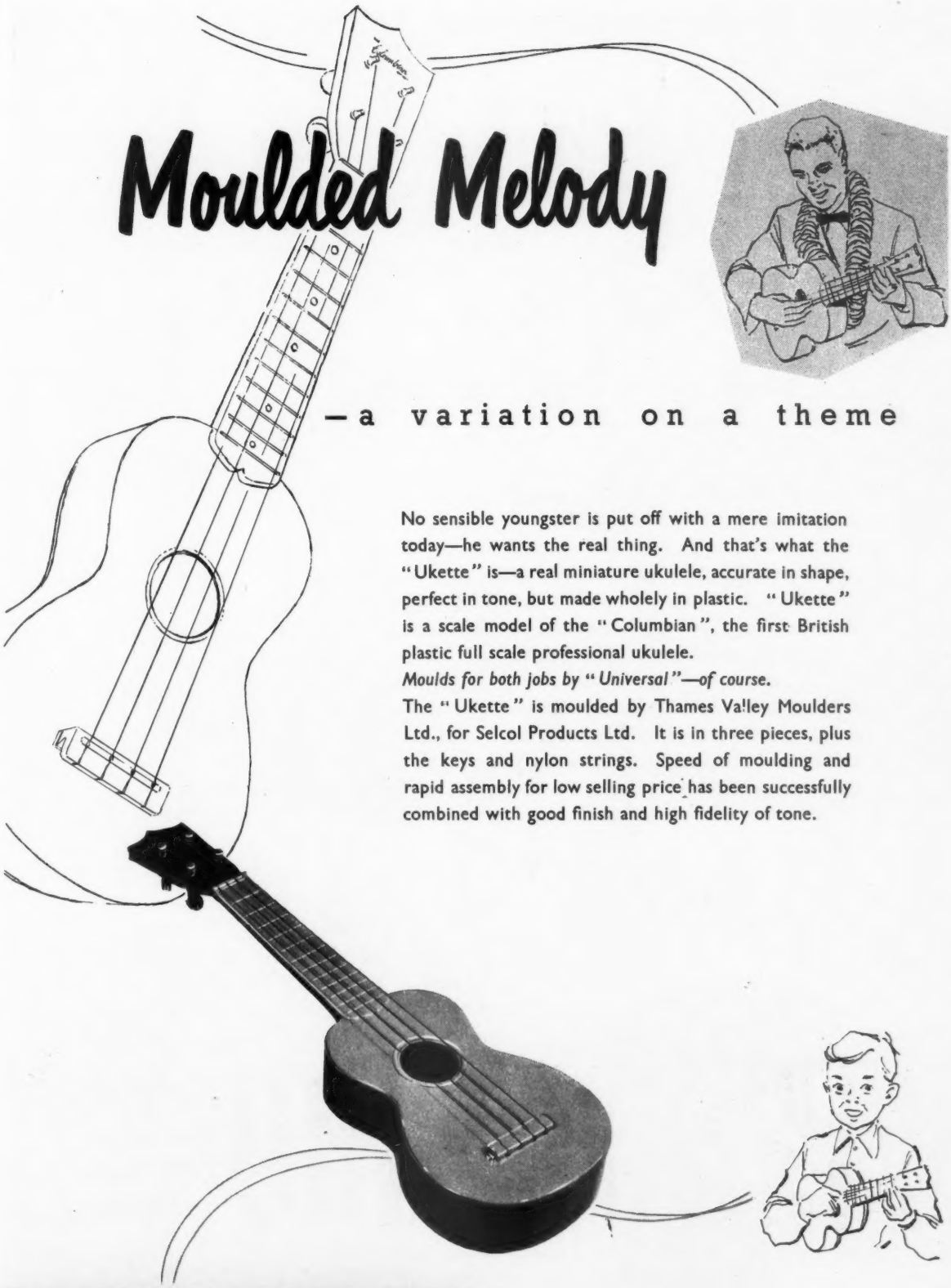
Moulded Melody

—a variation on a theme

No sensible youngster is put off with a mere imitation today—he wants the real thing. And that's what the "Ukette" is—a real miniature ukulele, accurate in shape, perfect in tone, but made wholely in plastic. "Ukette" is a scale model of the "Columbian", the first British plastic full scale professional ukulele.

Moulds for both jobs by "Universal"—of course.

The "Ukette" is moulded by Thames Valley Moulders Ltd., for Selcol Products Ltd. It is in three pieces, plus the keys and nylon strings. Speed of moulding and rapid assembly for low selling price has been successfully combined with good finish and high fidelity of tone.



Universal Tools Ltd

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Telephone: MITcham 1624

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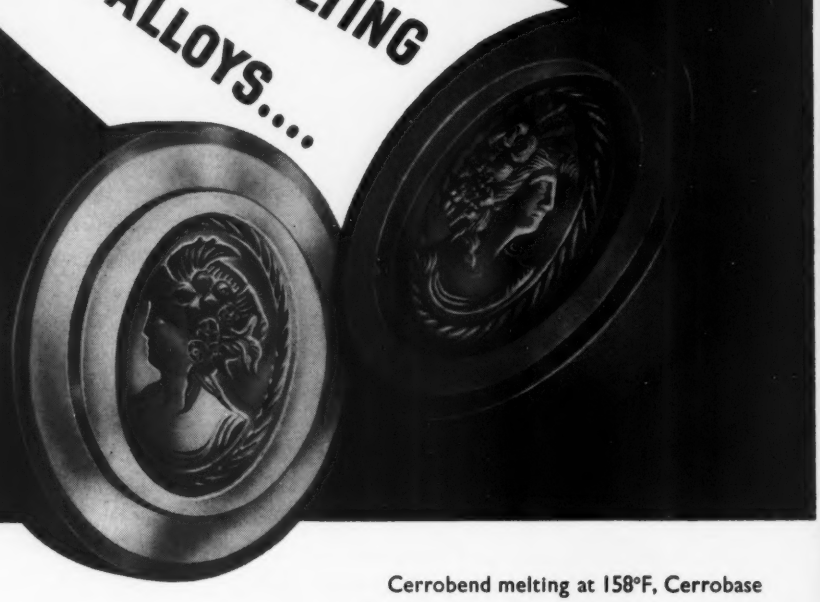

NO EXPENSIVE EQUIPMENT

NO HIGHLY SKILLED LABOUR

Cerrobend melting at 158°F, Cerrobase at 255°F and Cerrotru at 281°F are easily sprayed against master models with inexpensive equipment. The resultant negative cavity, reproducing the finest detail, provides excellent mould for short runs in thermoplastics. After use moulds may be re-melted and metal fully recovered.

★ Technical advice in selection and application of correct alloy to suit your problem available on request.

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Low-Temperature-Melting Non-Shrinking Alloys ALLOYS

MINING & CHEMICAL PRODUCTS LTD

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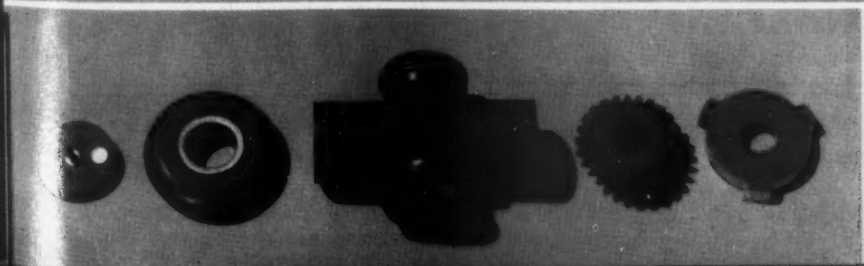

Delaron REG.
LAMINATED PLASTIC
MADE BY
DE LA RUE

—he hasn't heard of POLYSTYRENE

No, he hasn't heard of polystyrene—a rather long and complex word for a boy of his age. But most of his favourite toys are made from this comparatively new wonder material. And why are they his favourites? Because they are bright and light and stand up to a lot of hard play—and are *immediately* attractive to all children.

Two special grades of **tougher** ERINOID POLYSTYRENE offer many advantages to the toy manufacturer:

2·C·L is available at standard price level in an unlimited range of colours including crystal clear.

M·H·I does not shatter to give sharp edges. It is supplied at a very small premium.

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SP/P/3

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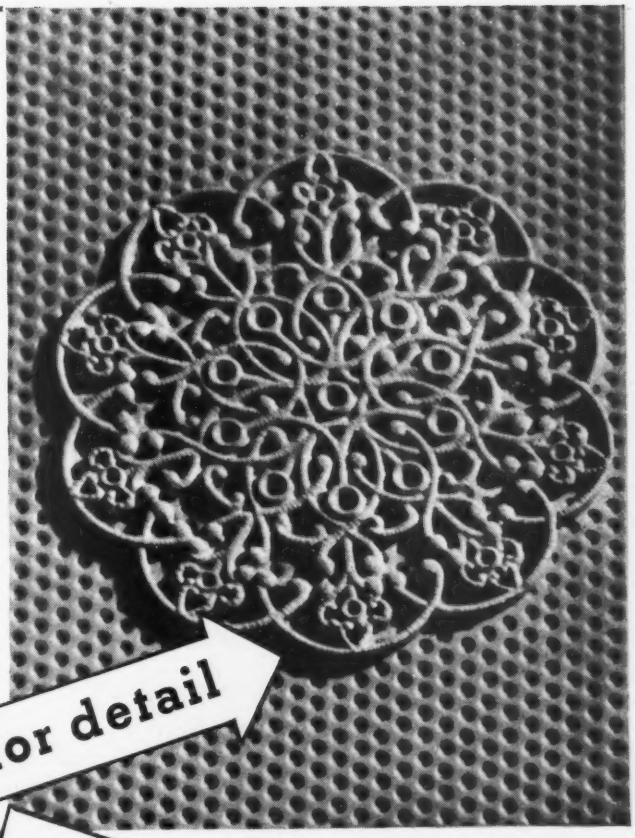
the new technique for
'Cellastine'
TRADE MARK
Acetate sheeting

Six advantages for Vacuum forming with 'Cellastine'



for detail

for finish

1. Accurate reproduction of mould detail.
2. Generous depth of draw.
3. High lustre finish.
4. Choice of colours or transparent.
5. Economical production.
6. Quick cementing.

'Cellastine' is tough, resilient, lightweight, washable and printable.

Demonstrations can be arranged by appointment.

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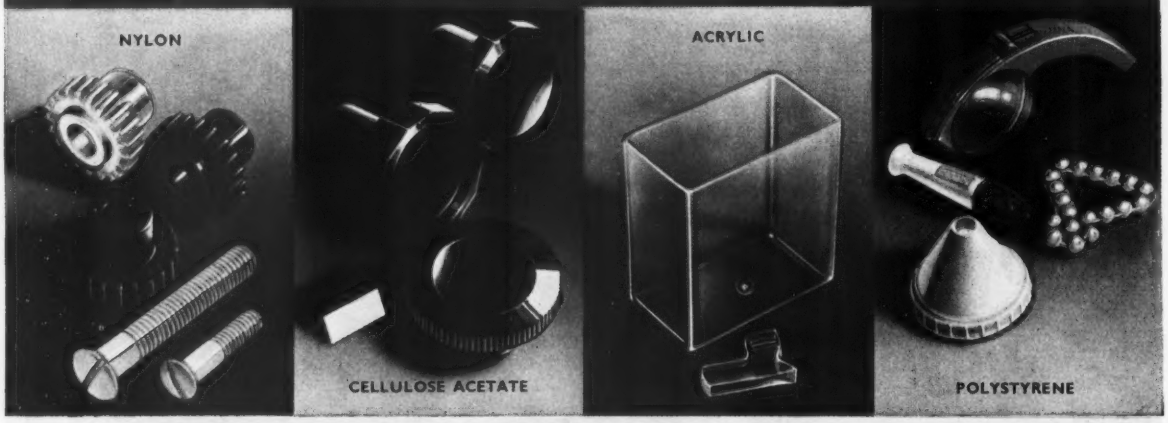
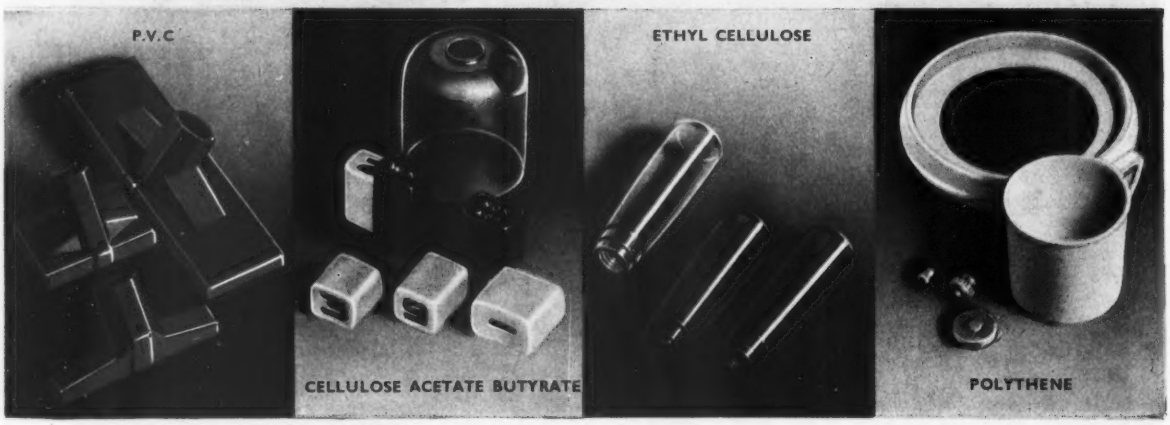
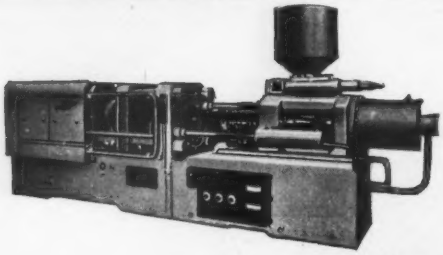
Insulators Ltd



injection mouldings





INJECTION MOULDING MACHINE

Insulators Limited are fully equipped to supply INJECTION MOULDINGS in quantity in the widest variety of materials and designs using modern plant and equipment with machine capacity ranging from 1–32 ozs.
Illustrated above are a few examples of the extensive range of Thermoplastic materials in which Insulators Limited produce components. Their experience extends over 25 years and embraces every branch of plastic moulding technique. All the unique skill and comprehensive technical knowledge of Insulators Limited are at your disposal.
Inquiries are invited and will receive prompt attention.

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BRANCH FACTORIES: JARROW, DURHAM, AND PADDOCK WOOD, KENT
Telephone: Tottenham 1491 *Telegrams: Mermould, Southtot, London*

Fourth Dimension

We are permitted, by kind permission of Jupiter, Venus and the Council of the ancient gods, to reproduce an extract from their June Minutes :—

> "*In the month of Juno and in a period known to man as* 1953, *a mortal—Nestorite—dwelt with us for a period on the heights of Olympus, and being as one of us, acquired much of our celestial knowledge.*"

In modern English, it means of course that at the last British Plastics Exhibition, Olympia, our temporary locality was up "with the gods". It may sound nice to be amongst the "high-ups" but certain complications have resulted.

As Jupiter and the other ancient deities live in the Fourth Dimension, Time and Space do not exist. Thus a hundred years ahead means the SAME as a hundred years ago, and a delivery of Moulding Powders to, say Carlisle, represents the SAME distance as separates our foremen from their nearby "Local".

So Nestorite, after his association with "the gods" at Olympia, is now urging us to adopt the Fourth Dimension and make Ferguson Service so infinitely flexible that orders received today can be delivered *yesterday*!

As a preliminary, we are acquiring a Jet Liner for deliveries, and equipping our Technical Staff with helicopters for "dropping-in" on customers. Meanwhile, we refer you to the adjacent formula of a "Nestorite" Powder, specifically produced for Flexible Mouldings.

NESTORITE **GRADE A. 1022**

FLEXIBLE

Filler	Woodflour
Particle Size (inches)	1/10
Specific Gravity	1·35
Bulk Factor	2·4—2·7
Powder Density	·50—·55
Time of Cure of Test Cup (secs.)	60—80
Recommended flow range	5—10
Shrinkage (thou./inch)	6·0—7·5
Flowability (cm.)	10—11
Impact Strength (ft./lb.)	·15—·22
Tensile Strength (lb./sq. in.)	5,000—8,000
Elastic Modulus in tension (lb./sq. in.)	$3—7\times10^5$
Water Absorption (7 days) (mg.)	100—200
Plastic Yield Grading (°C.)	100
Electric Strength at 90°C. minute value (V/mil.)	80—100
Surface Resistivity after immersion (log ₁₀ ohms)	10—11
Volume Resistivity (as moulded) (log ₁₀ ohm cm.)	11—12

Suitable for moulding around heavy metallic inserts, such as saucepan handles. Slow-curing but amenable to pre-heating. Very long flow. Also suitable for certain mouldings where moulding pressure is abnormally low.

YOU'RE RIGHT WITH "NESTORITE"

JAMES FERGUSON & SONS LTD.

LEA PARK WORKS, PRINCE GEORGE'S RD., MERTON ABBEY, LONDON S.W.19.

Telephone MITCHAM 2283 (5 LINES) *Telegrams* NESTORIUS SOUPHONE LONDON

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134, Avenue de Villiers, Paris 17, France.

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Angel Baixeras, 39, Barcelona (2), Spain.

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THE PLASTICS DIVISION OF IMPERIAL CHEMICAL INDUSTRIES LIMITED

is organizing an

EXHIBITION AT THE TEA CENTRE, LOWER REGENT STREET, LONDON

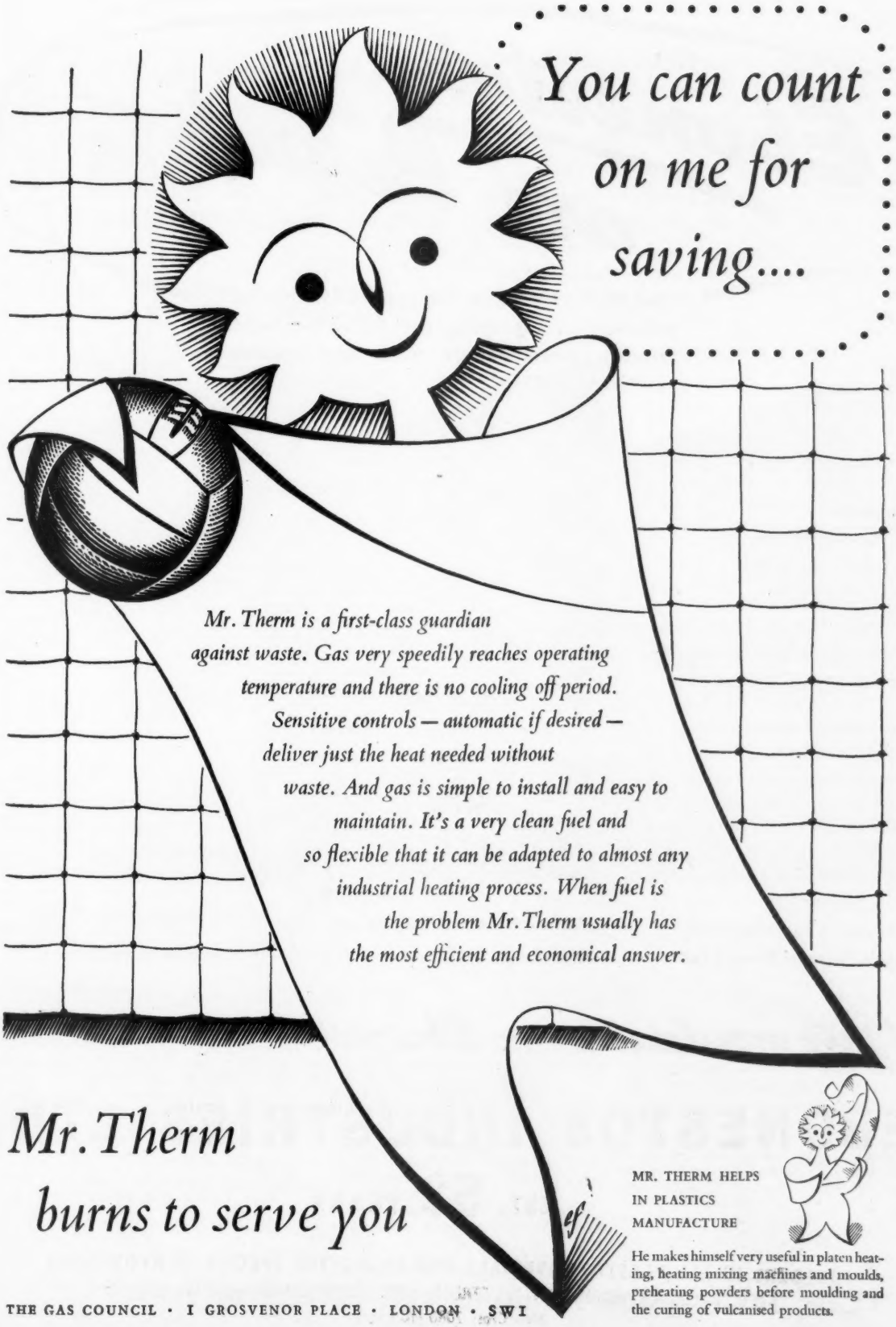
on February 15th - 20th

Signs by Acme Showcard & Sign Co., Ltd.

Invitations may be obtained from I.C.I. Regional Sales Offices in London, Birmingham, Manchester and Glasgow, or from:—

IMPERIAL CHEMICAL INDUSTRIES LTD., LONDON, S.W.1

P.454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Mr. Therm is a first-class guardian against waste. Gas very speedily reaches operating temperature and there is no cooling off period. Sensitive controls — automatic if desired — deliver just the heat needed without waste. And gas is simple to install and easy to maintain. It's a very clean fuel and so flexible that it can be adapted to almost any industrial heating process. When fuel is the problem Mr. Therm usually has the most efficient and economical answer.
Mr. Therm burns to serve you
MR. THERM HELPS IN PLASTICS MANUFACTURE
He makes himself very useful in platen heating, heating mixing machines and moulds, preheating powders before moulding and the curing of vulcanised products.
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that their reputation has earned for them the privilege of supplying the following world-famous undertakings with high-precision plastic mouldings :

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If it's mouldable — Ebonestos can mould it

EBONESTOS INDUSTRIES LTD.

EST. 53 YEARS

MOULDERS IN ALL PLASTIC MATERIALS AND EBONESTOS SPECIAL COMPOSITIONS

EXCELSIOR WORKS, ROLLINS STREET, NEW CROSS, LONDON, S.E.15

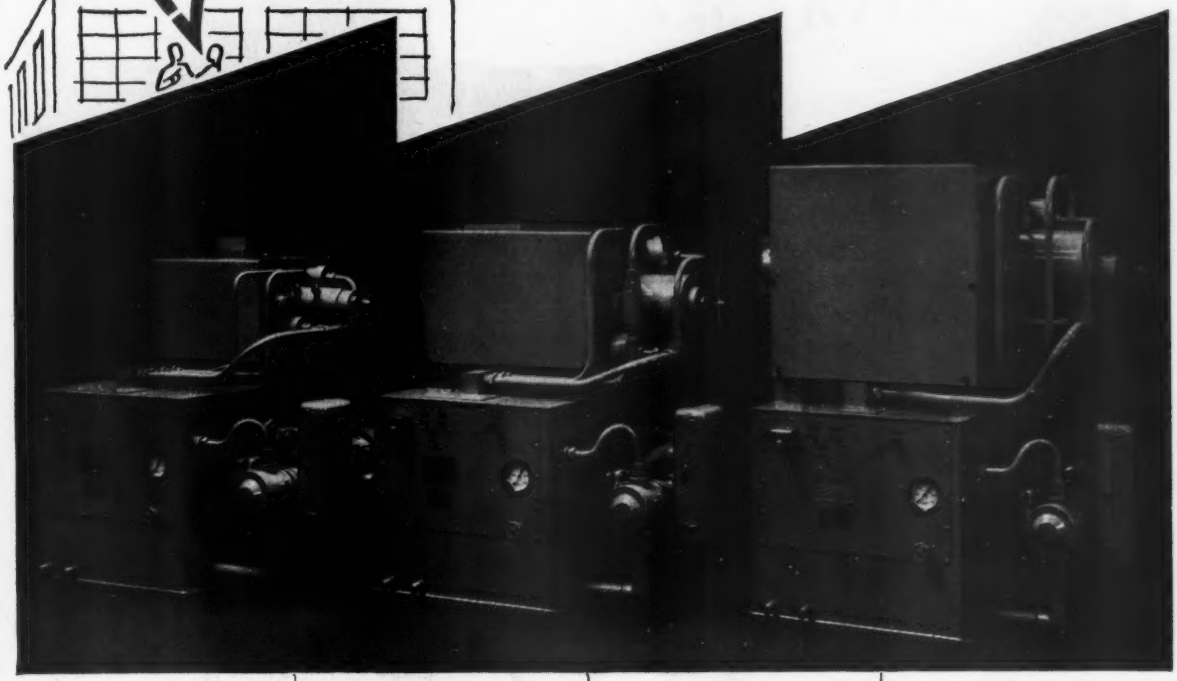
New Cross 2080 (20 lines)

It's no trouble at all with

BIPEL

Horizontal Hydraulic Pelleters

The advantages of hydraulic pelleting combined with the speed of a mechanical pelleter and minimum maintenance requirements . . . that is BIPEL'S contribution to the job of making sound moulding preforms and making them quickly. How is it done? By using the main ram for compressing the powder only; filling and ejecting depend on rapid movements of the die and hopper.



	12 TON	35 TON	70 TON
Maximum dia. of pellet	1¼″	3″	4½″
Maximum strokes per hr.	2280	1260	720
Maximum fill	2″	3¼″	3½″
Overall dimensions	4′ 6″ x 3′ 6″ x 5′ 3″ high	4′ 6″ x 3′ 6″ x 6′ high	4′ 6″ x 3′ 6″ x 6′ 9″ high
Weight	20 cwt.	30 cwt.	35 cwt.

IN HYDRAULIC PELLETING, powder is compressed not by a blow as in a mechanical pelleter, but by a steady squeeze. In the BIPEL pelleter both the pressure 'dwell' and the amount of pressure applied can be accurately adjusted in a few seconds to suit the powder being pelleted. These in themselves are advantages: but there are others, for example:

1 No moving parts come between the punches, so the machine cannot suffer damage.

2 There is no powder spillage because filling takes place *in* the hopper.

3 The die is free during the squeeze so that the action is equivalent to applying pressure to both punches. This gives consistent density.

4 The maximum pressure cannot be exceeded so that there is no danger of a major breakdown due to the machine being over-stressed.

5 Adjustment of pellet weight is very simple and can be made while the machine is running.

6 Round, square, rectangular, and ring pellets, etc., can also be made.

7 Multiple punches can be fitted within the pressure capacity of each machine to increase production.

8 An auxiliary hopper with motorised agitator can also be fitted to feed very fine powder and semi-shock resisting materials.

The machine is completely self-contained with its own motor and pump (shop air supply is used for the controls). Since pressure only builds up during the squeeze and ejection, the motor is running light most of the time. Power consumption is remarkably small and maintenance charges are low.

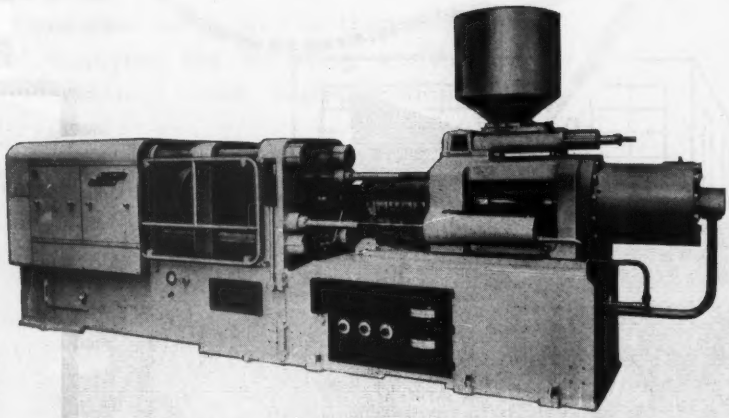
Invest in BIPEL *Hydraulic Moulding Plant*

B·I·P GROUP

B.I.P. ENGINEERING LTD., STREETLY WORKS, SUTTON COLDFIELD, ENGLAND

F

facts that speak for themselves



"SUNNYCAGE" BIRD CAGE

WEIGHT—500 grams each half of cage (the cage is moulded in two identical sections from one tool and chemically welded).

MATERIAL - Polystyrene

TIME - - 25 per hour

Moulding by EKCO Plastics Division for and to the design of "Sunnytoys" (Distributors) Ltd., of Blackpool.

Mould designed and made by EKCO Plastic Division.

The design and proved performance of PECO Injection Moulding Machines result in the production of plastic articles of the widest range, from simple domestic goods to intricate mouldings such as this Bird Cage illustrated. Always these machines give the same perfect, undeviating production flow. Do you ask for impartial recommendation? It comes from the manufacturers all over the world who have installed them.

Illustrated literature describing the full range of PECO machines will be sent on request.

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PECO MOULDS. Expert designers and mould makers are employed and moulds can be supplied to samples submitted, including die-sinking models if required. An important side of the Company's work is the hobbing of cavities for moulds and medallions—the plant includes a 3,000-ton hobbing plant. Master hobs to customers' samples made as required.

The

PROJECTILE & ENGINEERING COMPANY LIMITED

ACRE STREET, BATTERSEA, LONDON, S.W.8, ENGLAND

Telephone: Macaulay 1212 Telegrams: "Profectus, Claproad, London" Cables: Profectus, London

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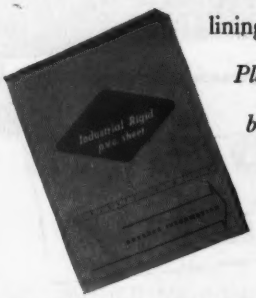
Bakelite Limited have developed a tough, thermoplastic rigid PVC sheet, 'VR215', with exceptional resistance to chemicals. It is ideally suited for the construction or lining of tanks, ducting etc.

Please write for 'advance information' booklet and samples.



Cut it to Shape ***(it's easily drilled, sawn, sheared or formed)***

Fit it in Position ***(it's light and easy to handle)***

Weld the Joins ***(easily done; we supply the welding rods)***

Our Service Engineers are available to demonstrate welding and forming techniques

VR 215 is supplied in sheets 48″ × 36″; thicknesses up to ½″.

- *Non-inflammable.*
- *Abrasion-resistant.*
- *Permanently withstands most chemicals.*
- *Immediately available.*
- *Matching rod and tube available for pipe lines, valves etc.*

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Regd.

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VR2A

BRIDGE

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FOR

PRECISION

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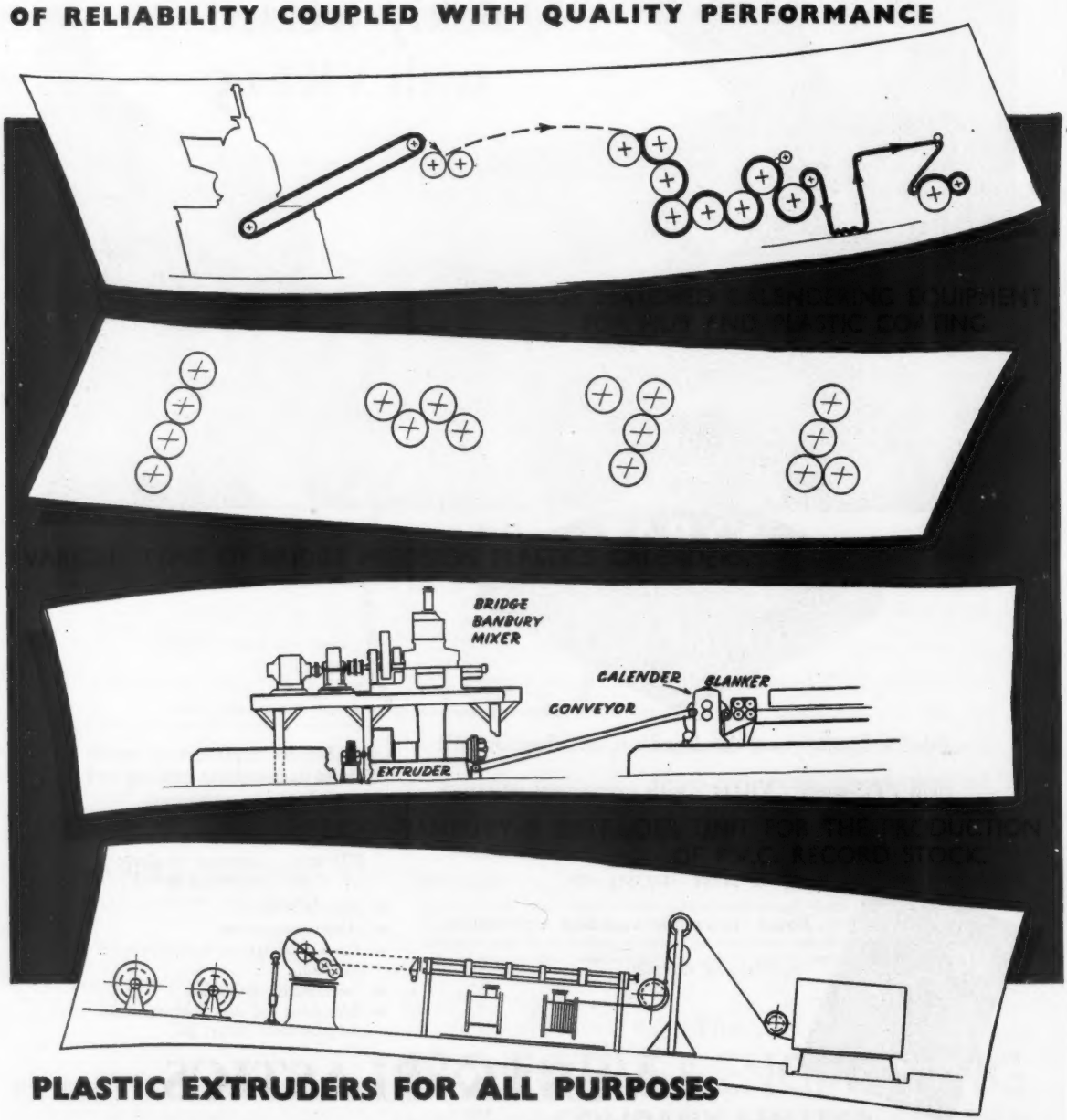
OF RELIABILITY COUPLED WITH QUALITY PERFORMANCE



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RCL MOULDING POWDERS

FM.2 BLACK

POWDER DENSITY (gms/cc)	0.39
BULK FACTOR	3.5
PELLETING PROPERTIES	CANNOT BE PELLETED
SHRINKAGE (inch/inch)	.005—.007
DENSITY OF MOULDINGS	1.35
IMPACT STRENGTH (ft./lbs.)	0.28—0.32
TENSILE STRENGTH (lbs./sq.inch)	6000—8000
WATER ABSORPTION (mgms)	110—150
ELECTRIC STRENGTH @ 90°C. (volts/mil)	50—80
ELECTRIC STRENGTH @ 20°C. (volts/mil)	150—250
SURFACE RESISTIVITY (megohms/cm²) (1) FRESHLY MOULDED (2) AFTER 24 HRS. IN WATER	10^4—10^5 10^3—10^4
VOLUME RESISTIVITY (megohms/cm³)	10^5—10^6
CURE : SECONDS TO OBTAIN A BLISTER FREE CUP	70—75
MOULDING TEMPERATURE	300°F—330°F

FM.2 is a pure phenol, medium shock resisting powder with a cellulose filler. It conforms to BSS 771 : 1948, Type MS and is specifically recommended for use in connection with CS 1790E. This powder can be A.I.D. and C.I.A. released and is approved against the radio components specification RCS 1000, grade 5b. Supplied in a wide range of flows in black and various colours

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MOULDING POWDERS • FINE COLOURS • CHEMICALS

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RCL

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TP DUNSTABLE

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ACETONE

High-purity solvent in the formulation of surface finishes.
Typical analysis:
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Acidity as acetic acid: 0.0005% by wt. maximum.
Permanganate fading time: more than six hours.

ETHYLENE GLYCOL
DIETHYLENE GLYCOL

Ethylene glycol, Grade S, a plasticiser for transparent cellulose film; solvent for basic dyestuffs; intermediate in the production of alkyd resins, polyesters, and other ethers and esters.

Diethylene glycol, a plasticiser; solvent for dyestuffs, gums and resins; intermediate for solvent ethers and esters.

Also available: FURFURYL ALCOHOL, NONANOL, 'ALPHANOL' 79

ICI

INFORMATION FROM
IMPERIAL CHEMICAL INDUSTRIES LIMITED
LONDON, S.W.1.
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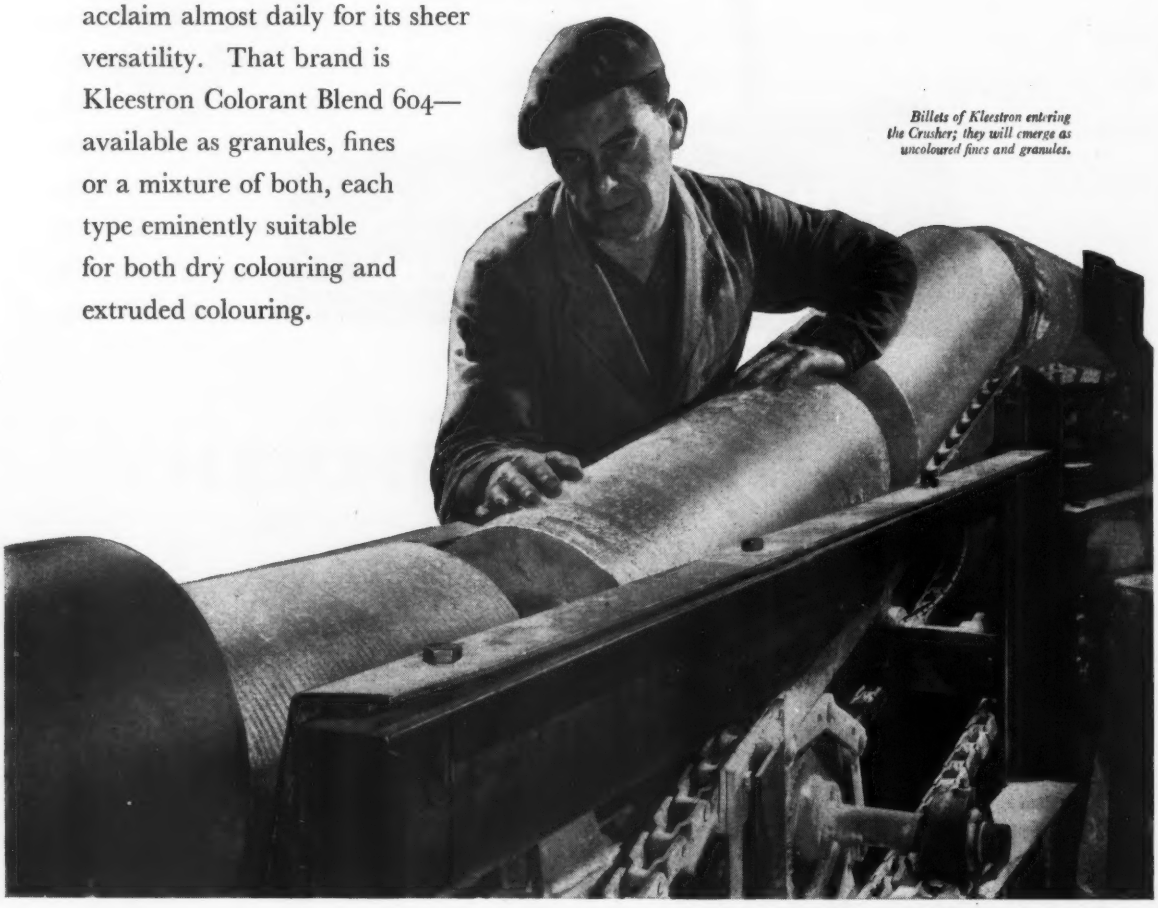
KLEESTRON

Colorant Blend 604

the *VERSATILE* plastic

The world over, polystyrene is renowned for its cheapness, lightness and for the infinite number of ways it can be used. The world over, too, one brand of polystyrene is winning (and deserving) fresh acclaim almost daily for its sheer versatility. That brand is Kleestron Colorant Blend 604—available as granules, fines or a mixture of both, each type eminently suitable for both dry colouring and extruded colouring.



Billets of Kleestron entering the Crusher; they will emerge as uncoloured fines and granules.

SOLE SELLING AGENTS FOR UNITED KINGDOM:
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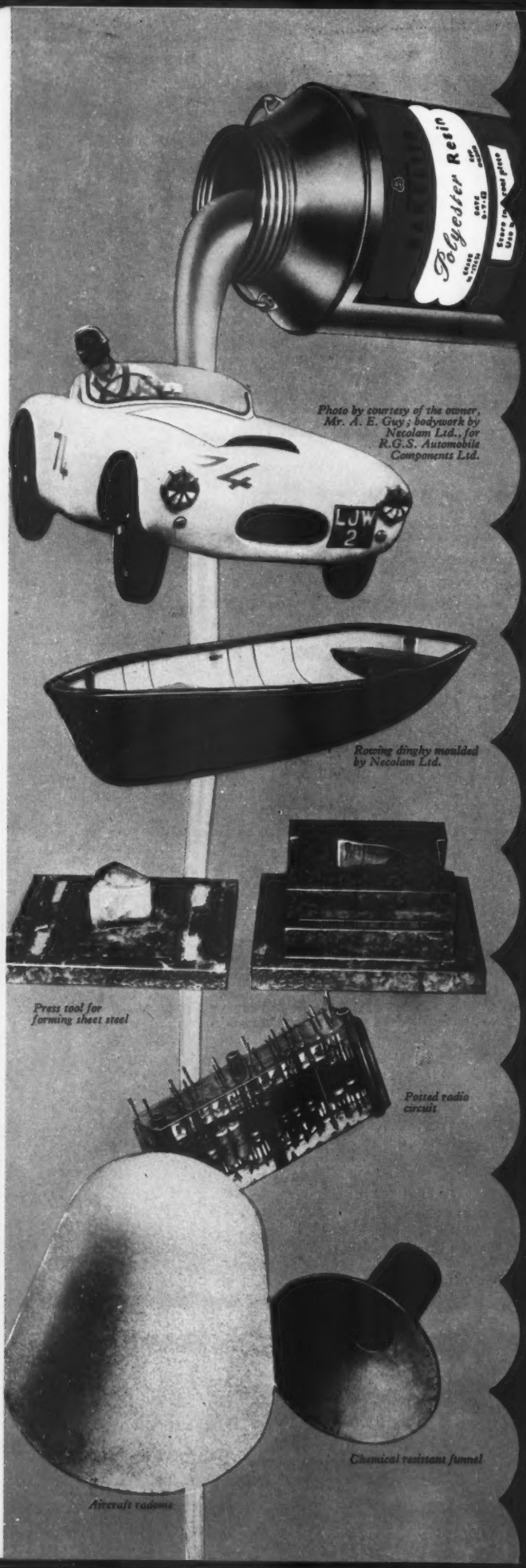
Polyester Resin
Photo by courtesy of the owner, Mr. A. E. Guy; bodywork by Necolam Ltd., for R.G.S. Automobile Components Ltd.
74
LJW 2
Rowing dinghy moulded by Necolam Ltd.
Press tool for forming sheet steel
Potted radio circuit
Chemical resistant funnel
Aircraft radome

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In a wide variety of industries, BAKELITE Polyester Resins continue to find new applications for glass fabric laminating, low pressure mouldings, and special castings. The following resins with suitable catalysts and accelerators have been developed by Bakelite Ltd., and the details given below will probably suggest many ways in which these materials can be of value to you.

SR 17431—a high quality hard resin with good electrical properties; recommended for structural applications and translucent laminates where colour is important. Particularly suitable for reinforced castings such as press tools, and structural applications such as car bodies and boat hulls.

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SR 17486—a lower viscosity resin, specially developed for the production of translucent roof sheeting.

SR 17449—a resin with outstanding electrical properties and exceptionally high chemical and heat resistance. It is officially approved for "potting" electronic circuits and for the production of Radomes and aircraft ducting (D.T.D. 900E).

SR 17438—a flexible resin used mainly for adjusting the mechanical properties of other BAKELITE Polyester resins but occasionally used by itself for shock resisting applications.

Information leaflets on these materials will be sent on request to any of our sales offices, and a technical advisory service is available.

TREFOIL

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First and Still Foremost

Products of Bakelite Limited include: Synthetic Resins, Cements and Adhesives · Phenolic, Urea, Alkyd & Silicone Moulding Materials · Laminated Sheet, Rod & Tube · Glass Fibre and Asbestos Laminates · Rigid & Flexible PVC Sheet · PVC Moulding & Extrusion Compounds · Decorative Laminated Plastics

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Sales Offices: LONDON, Sloane 0898; BIRMINGHAM, Midland 5911/4; MANCHESTER, Blackfriars 5174/7; GLASGOW, City 6825

Plastics

DEALING WITH THE MANUFACTURE, USES AND POTENTIALITIES OF PLASTIC MATERIALS

PROPRIETORS: TEMPLE PRESS LIMITED

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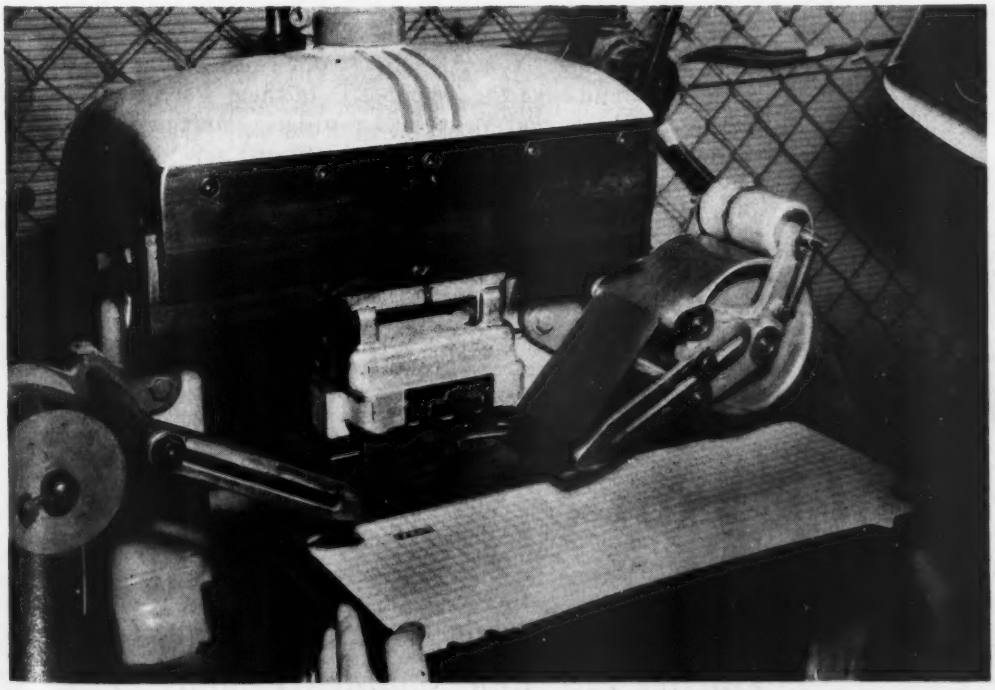


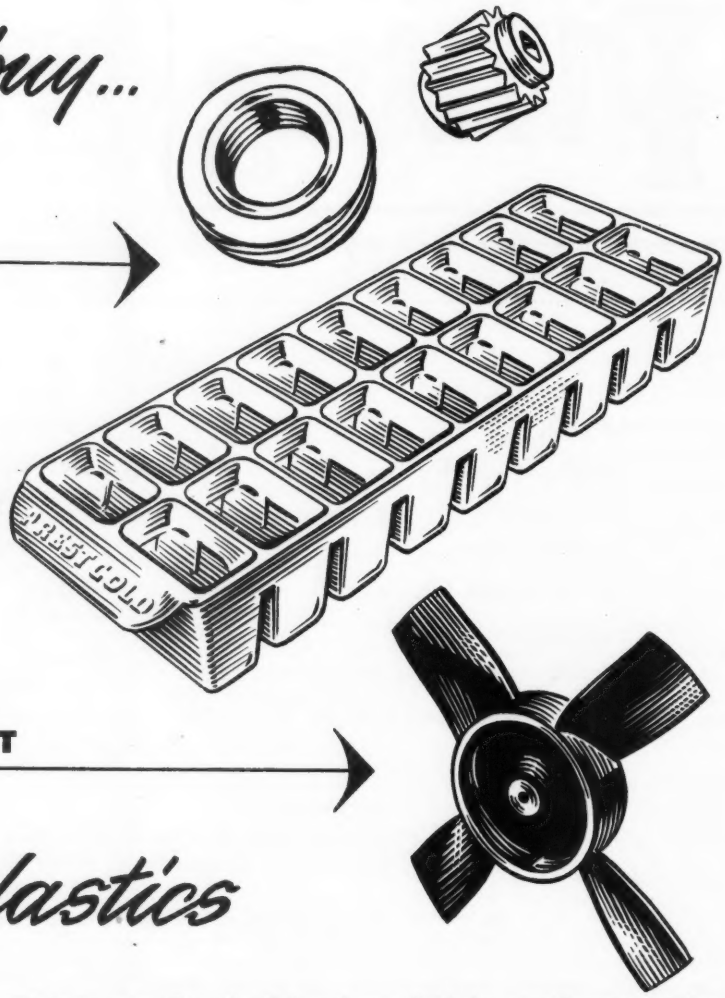
The Funditor Process is used by E. K. Cole to stamp the company's emblem on the thermoplastic grille of a radio set. The grille is held in position by a simple jig.

When you buy...

A MOTOR CAR

A REFRIGERATOR

A VENTILATING UNIT



you buy plastics

Look into your Standard 8 and you find the speedometer drive gears are moulded 'Nylon' — open your Prestcold refrigerator and take the ice cubes from their 'Polyethylene' tray — switch on your Vent Axia ventilating unit and the moulded 'Phenolic' impeller gets to work.
These different uses for three different plastics materials are all moulded in large quantities at our Walthamstow factory. It is our business to develop and produce sound applications of moulded plastics for industrial uses. Designers and development engineers are always ready to collaborate with potential users of plastics, preferably at an early stage in the design of the product.

NATIONAL PLASTICS (SALES) LTD.

sales organisation for British Moulded Plastics Ltd. and Moulded Products Ltd

NP2

AVENUE WORKS, WALTHAMSTOW AVENUE, LONDON, E.4. . . . *LARkswood 2323*

Plastics

VOL. XIX. No. 198 JANUARY, 1954

EDITORIALS

The Past Year and The New

PHILOSOPHERS may argue as to what makes a nation happy—absence of wars, plenty of food, hard work, more leisure, Government-made social security or even sponsored television, but these neutral or positive benefits compare but poorly with the happiness of spirit that enveloped the whole country in the year of the Queen's Coronation. It is given to few individuals to make large numbers of people happy, but by her own personal quality and her regality, the Queen has created a happiness and a sense of unity in the hearts of a hundred million of her subjects in our Commonwealth of Nations, the like of which no living man remembers. We need not puzzle our brains to translate this emotion into terms of our everyday life and worries. It is good enough to have received the spark of that emotion, even for a tiny fraction of a second in a day, a year or a lifetime.

THE year that has just ended was certainly one of growing optimism and of gradually improving conditions and production. In 1951 and 1952 the "buyers' market" was in full swing and in many instances prices of raw material dropped. Cellulose acetate, polystyrene and "phenolic" resin-producing factories felt the effect of the change and worked short-time—one "phenolic" resin works had closed down temporarily. The second half of 1953 saw a rapid change for the better and all works are now in production again. On the other hand, in the fields of polythene and polyvinyl chloride and where "phenolics" touched the metallurgical industry, progress was continuous throughout the year. As an overall result, exports were eminently satisfactory; it has been estimated that a total of 50,000 tons of plastics materials were sent overseas by the end of the year. It is useful to remember that this figure is equivalent to a tonnage some 70 per cent. higher than the total production of all plastics materials in this country in 1938. Few other industries have done so well.

The spectacular power of plastics to surprise the world—and now even the more thoughtful and technical section of it—continues to grow rather than to diminish. The greatest developments that have drawn world-wide attention are those that have taken place in the thermoplastic field, in polythene and polyvinyl chloride technology, and in the thermosetting field with advances in the application of polyester resins. On the other hand a great fillip to the phenolic resin industry is promised by the comparatively sudden, spreading use of shell moulds bonded with these resins, for metal casting.

As for polythene and hard polyvinyl chloride both are now being widely employed for important industrial and non-industrial purposes after a long period of testing. The Minister of Supply has recently announced the adoption of large diameter polythene tubing, which can be laid very quickly and with little manpower, for conveying water to special storage tanks in the event of another war and the use of the atomic bomb. (The most recent information on the use of plastic piping in Civil Defence is discussed on another page in this issue.) At the same time the Minister announced the adoption of a plastic static water tank which can be easily and quickly erected in similar circumstances. Presumably this is of the same type (that is, made from polyester resin bonded glass fibre) as that shown at the British Plastics Exhibition in June, 1953. Additional developments in polythene tubing for water conveyance have been made in the field of agriculture especially on large estates and farms where simplicity and rapidity of laying introduces considerable savings. The improvement of agriculture in underdeveloped countries is obviously an even more promising outlet.

Polyvinyl chloride has also been much in the limelight in industrial spheres. The most important steps forward were first announced in 1952 when it was decided to equip all underground mine conveyors with polyvinyl chloride belts instead of rubber belts as a result of the Cresswell Colliery disaster, and to provide rough-weather clothing, made from the same basic material, to the Navy. The present year saw the continuation of this equipment on an enlarged scale. Hard polyvinyl chloride tubing for water and acid conveying has been widely adopted in chemical and other works, as have welded structures made from the same material in sheet form as acid tanks, acid fume ducts and acid-proof fans not only for chemical factories but also for works in allied industries—metal pickling, photogravure, electroplating, etc.

Public attention has been drawn more especially to the polyester resins and their reinforcement with glass fibre. From these materials have been constructed dinghies and small yachts, aircraft parts such as radomes and wing structures, washing-machine agitators, small petrol tanks and many other industrial components. The year 1953 was noteworthy in this field for the announcement and exhibition of a number of guided missile shells, even more spectacularly of several attractive motor-car bodies and a static water tank for Civil Defence purposes to which reference has already been made above. Obviously the plastic motor-car body has held the public imagination most and a few, quite superb in design, have been made in this country by enthusiastic amateurs, some with the blessing of motor-car manufacturers. While in the U.S.A. one or two well-known companies are stated to have begun manufacture of hundreds of sports cars of this type, manufacturers here are more reserved, believing that much more must first be learned about behaviour of such shells on the road and on the "ageing" of the resin/glass fibre structure before approaching the production stage. Almost all, however, have experimented and have produced interesting structures. They are, at present at any rate, more interested in the probable savings to be made in employing plastics for new model-making and in plastics for producing press tools.

The Supply Situation

THESE almost startlingly rapid developments in the past five years or so raise the problem of supplies of two of these extremely important materials, polythene and polyvinyl chloride. So far as polythene is concerned, the present production in this country is of the order of 15,000 tons a year and in the next year or so when the I.C.I. Wilton plant is completed should be about 30,000 tons. In itself, this great increase in production of 100 per cent. would take charge

of any conceivable new demands that may arise in this country for a good number of years. But obviously the problem is far wider than this, for technical expansion and agricultural expansion is being pursued in almost every corner of the globe. The increasing world demand has clearly been foreseen, for several companies in the U.S.A. are manufacturing polythene under licence from the inventors, Imperial Chemical Industries, Ltd., although an indication of the present overall situation in the U.S.A. itself, was seen in the purchase towards the end of the year from I.C.I., Ltd., of 2,000,000 pounds weight of polythene. However, more relief is promised by the recent announcement that Canadian Industries, Ltd., has decided to expand its production to 7,000 tons a year using ethane from Alberta natural gas, and by yet another that Ethylene Plastique S.A. is constructing plant under licence from I.C.I., Ltd., in France.

As for polyvinyl chloride, production is considerably higher than that of polythene—the number of uses is much greater. While the capacity of the I.C.I. plants when complete has not been generally disclosed, presumably it will be more than 30,000 tons a year. The British Geon plant at Barry is operating at capacity between 12,000 and 15,000 tons a year, and we now have a third manufacturer, Bakelite, Ltd., with a new factory at Aycliffe in County Durham, where the capacity is 5,000 tons a year, which is a very welcome addition to our resources. Expansion in production in either polythene or the polyvinyl chloride group of plastics cannot, unfortunately, be as rapid as one would like owing to the character of the raw materials, the complexity of the plant, the extreme care which must be taken in creating expert personnel and high costs involved.

MOULDING POWDER AND SHOT

Mr. Mischa Black, a director of the Design Research Unit, is reported in a recent edition of the *Sunday Dispatch* as having said of plastics: "They're terrible things, but I suppose they have their important functions. People nowadays say of plastics—'They're modern, therefore they must be good.' That's nonsense." I don't usually pay much attention to odd snippets in the non-technical Press in case they are not adequate reports, but the quotation appears to bear hard on our industry. I well remember that the Plastics Institute during the past war I believe, gave Mr. Black a whole evening to teach us all about art so that at the end of it we knew as much about art as he did of plastics. Since that date, although we have not followed closely his work in our field, no doubt his knowledge has increased following the usual equation $K = C(x/y)$ where C is an exceptionally large constant compared with x, the number of years that flow under bridges. I've forgotten what y is.

Lord of Art Speaks

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Readers cannot really say that I don't keep them informed about the world that really matters. The latest information concerns Art—in fact, Music, and I read from my bedside weekly entitled *Stage* that Miss Ivy Benson has returned to London from somewhere or other with her new 23-piece, all-women orchestra and "has brought with her a £20,000 plastic saxophone of white and gold." This, as you well know, brings the plastic saxophone as an insurable object well within the province of Stradivarii and no doubt, as time goes on, will surpass it. I am rather puzzled, however, by the fact (surely I did not dream it!) that I saw one famous moulding company—to wit British Moulded Plastics, Ltd.—turning out the plastic bodies from their injection machines at a very pleasing rate, and unless Ivy's instrument has solid gold what-nots and is jewelled with large diamonds in every joint, I think she could have got quite a good sax in full working order for less than £20,000. But perhaps she's got hold of the prototype, in which case, of course—girls will be girls.

Music of the Spheres

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It is now two or three years ago that I was writing about the dangerous world shortage of sulphuric acid. In a recent issue of *Chemical and Engineering News* I read an encouraging, but in some ways curious, note: "English chemical production has been helped less by E.C.A. (Economic Co-operation Administration) than other countries, partly because of the independence and conservatism of the British and by the fact that her plants were in better shape. One of the most drastic changes in England was converting sulphur burners to pyrites burners which consume much more plant space, calling for enlarging and remodelling." I don't know if the words "independence and conservatism" are used in a praiseworthy or derogatory sense, but we might point out that England began sulphuric acid before most other nations in 1746, learned all there was to know about production from low-grade Italian sulphur, Spanish pyrites and spent oxides, and changed over to high-grade Texas Gulf sulphur when it became available after the first world war. When the shortage of the latter struck the world recently, the necessary change back to pyrites and pyrites burners was an appalling headache and very costly; but the knowledge and vast experience was in every works in the country. High-grade sulphur is still being allocated to acid manufacturers, many of whom will be forced to keep using pyrites until the situation clarifies. British manufacturers have done wonderfully and if the job hadn't been tackled energetically and wisely something very sad would have happened to every single industry including the plastics industry. It may be called independence not to sit with our arms folded and it may be called independence to have formed the United Sulphuric Acid Corporation in order to safeguard ourselves in the future—but it can't be called conservatism.

Job Well Done

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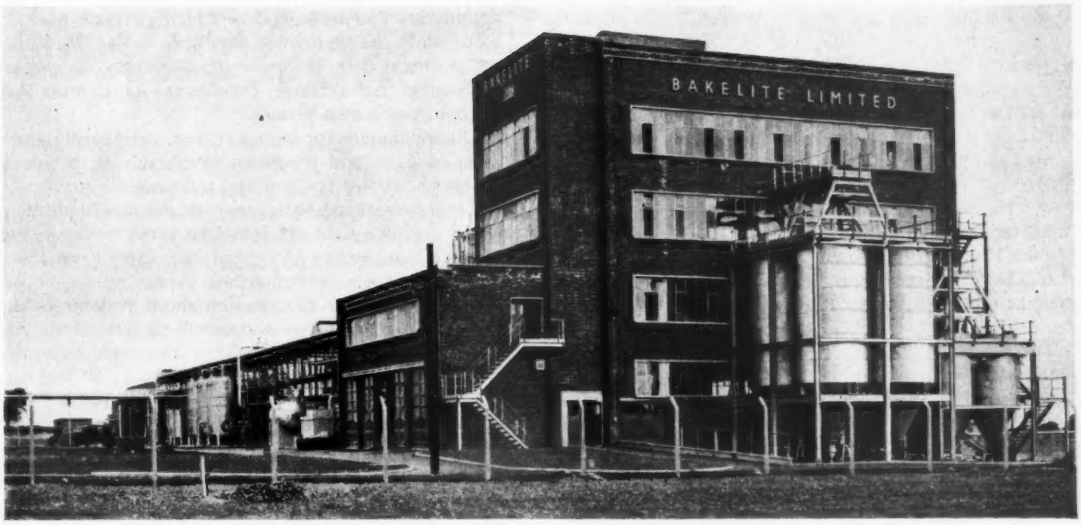
More than 15 years ago, I remember, I was asked what I knew about the possibilities of making plastics, that is moulding powders, from fish waste. I knew nothing except that the idea was not new and that any protein, as in casein, could be treated with formaldehyde to produce a hard, hornlike substance. Shortly afterwards I received a general note on the subject from a Norwegian organization that had carried out a great deal of research work on the subject. Today I note the announcement that the same company, Wm. A. Mohn and Son A/S, Bergen, has advanced sufficiently in the work to begin production and that the early samples which possessed the obvious drawbacks of odour and low water resistance have been improved, apparently by admixture of the extracted proteins with urea resins. It is claimed that the moulding powder resulting from formalizing the mixture has good flow properties, adequate hardness and excellent electrical properties. It would be pleasing to hear that complete success has been achieved in Norway, a country that sorely needs technical expansion. It has always puzzled me that Norway with her great waterfall system has not continued her success in other fields. I believe she led the world 40 or 50 years ago in the production of synthetic nitrogen and nitric acid from the air by the famous arc process, but so far as I know has not produced the nitrogen plastics.

A True Fishy Story

DOGSBODDY.



New Co-polymer Plant at Aycliffe

The completion of the new plant erected by Bakelite Ltd., at Aycliffe, Co. Durham, for the production of vinyl chloride-vinyl acetate co-polymers in addition to polyvinyl chloride resins, at a time when the demand for them is at its highest since they were first introduced, is a fact of major importance to our industry. On November 24, 1953 the new plant, which is now in active production, was thrown open to view by the Press.

ALTHOUGH Bakelite Limited is best known for its phenolic and urea thermosetting products—moulding materials, laminated sheet and resins—the company has, since the early days of the past war, been active in the thermoplastic field. It was in 1943 that they started the manufacture of vinyl resin compounds for cable covering at their dispersal plant at Feniscowles, Lancashire.

These compounds were urgently required to replace the rubber lost when the rubber producing countries fell to Japan. Primarily produced for electric cable insulation and for petrol tubing, the uses of vinyl resins and their fabricated products have steadily increased in number. These demands have continued to grow in spite of the fact that rubber has again been freely available for years, because vinyl resins have many important properties not enjoyed by rubber.

At the end of the war the company closed down their several dispersal factories, returning to the main works at Tyseley, Birmingham, such plant as could be accommodated there. Expansion at Tyseley was limited by a number of factors, and after consultation with the Board of Trade it was decided to develop a site at Aycliffe, Co. Durham, primarily for the production of thermoplastic products of which vinyl type polymers are a very important group.

A 35-acre site was selected which included a number of Royal Ordnance Factory buildings. Some were speedily adapted to take the vinyl compounding equipment from Feniscowles, and others used for administration, laboratories, stores, engineering and other services. However, these new facilities were insufficient and a building programme was immediately put in hand. The first phase was completed in 1948 and described in this journal at that time. The new buildings house a unit for the manufacture of phenolic moulding materials which is probably the largest and most up-to-date in the world, plant for the production of urea moulding materials and for compounding, calendering and press polishing p.v.c.

The second phase of the building programme was a new resin plant, and this plant commenced operation in September of the past year. It occupies part of a 47-acre site which the company has purchased immediately adjoining the original 35-acre site. It is a polymer plant, and consists essentially of low-temperature storage and mixing tanks for monomers, polymerizing equipment, drying, grinding and screening plant and weighing and storage facilities to handle the final product.

This new plant is designed to produce different types of polyvinyl and copolymer resins. Initial production is on the vinyl chloride-acetate copolymer of the well-known Vinylite "VYNW" type, which will be sold under the company's registered trade mark as Vybak "VYNW." Vybak "VYNW" is an excellent general-purpose resin, giving easier working, fluxing and plasticization than straight p.v.c. resins without sacrifice of mechanical and electrical properties. As has already been disclosed, this type of resin is produced in a restricted molecular weight range, the process resulting in a colourless clear plastic material. Present output is at the rate of thousands of tons per annum, and in addition to supplying the company's own requirements will be sold to other compounders, and so go some way towards meeting increasing demands of industry for vinyl materials. The plant capacity when complete will be of the order of 5,000 tons per annum.

The services, which are integral with the plant, comprise circulating water equipment and water storage, fire-fighting equipment, refrigeration and nitrogen units. The largest user of cooling water is the refrigeration plant. Nitrogen is required as an inert blanket in all pieces of equipment in which vinyl chloride is either stored or polymerized, and to keep free of vinyl chloride, instruments such as pressure gauges and containers where blockage by the polymer would result if the monomer was not excluded. Refrigeration is supplied to the reaction and storage areas as calcium chloride brine, which is produced by an ammonia compression refrigeration plant. The refrigeration plant is, in fact, one of the most important sections in the factory since the vinyl chloride monomer boils at a temperature well below the normal and the polymerization process itself is carried out in liquid form at low temperatures. It is especially noteworthy as will be seen from the accompany-

ing photographs that these main process sections are not built within a walled building but are quite exposed. This accords with modern conceptions of engineering and safety for all similar chemical processes including petroleum refining; obviously too, lower costs are a result.

Whilst normal operation of essential services and operating equipment depends on electric motors, steam-driven standby plant, as well as Diesel-driven generator equipment, automatically take over in the event of failure of the main power supply.

Raw materials such as vinyl chloride monomer arrive on site in road tankers and are off-loaded by pumps by gas pressure into the storage tanks which are grouped together in a tank area. From the storage tanks they are pumped to weigh tanks to make up feed mixtures of varying compositions corresponding to the type of resin being made, and these fed to the polymerization system as required. The polymerization system can manufacture resin by any of the well-known techniques, and is designed to give the flexibility necessary to cover a wide range of copolymer products with good material and service efficiencies. This section of the equipment is, as already stated, out of doors, but the final drying of the resin, its grinding, screening, blending and packing are carried out indoors. The equipment is entirely British made, and extensive use is made of stainless steel to ensure a clean product and freedom from corrosion.

Manufacture is controlled at all stages by the most modern servo-control mechanisms available, and extensive use of these has enabled the plant to be operated with a small labour force. Control of raw materials and intermediate products is covered by a qualified technical staff, covering the 24-hour service on a seven-day week basis necessary to ensure full cover during all periods of manufacture. Special attention is given to ensure that the finished resin is uniform in all characteristics, and it is tested not only for its physical and chemical properties as a resin, but also by its behaviour when used in a variety of compound formulations specially designed to show up any defects. The laboratories devoted to the aspect of manufacturing control are fully equipped for the complete evaluation considered necessary by the company.

The resins produced in this new polymer plant are either converted on the site into moulding or extrusion compounds or sheet, or despatched to customers who do their own conversion.

Initial compounding for both moulding and sheet materials follows the same course; through ribbon-type pre-blenders, Banbury mixers and two roll mills. For moulding and extrusion compounds, strips are fed into granulators where they are cut into chips of various mesh.

For the production of sheet, the Banbury and milled compounds are fed to calenders which produce material up to 54-in. wide and up to 30-thou. thick. The calendered sheet in roll form is then either supplied to customers for further processing—for example, embossing—or is press polished in the company's own presses.

The equipment for compounding, calendering and pressing is up to date, and compares favourably with corresponding equipment in this country and overseas.

It will be realized, therefore, that the thermoplastic products of the Aycliffe plant fall into four groups—copolymer resins, moulding and extrusion compounds, calendered sheeting and rigid and flexible press polished sheet.

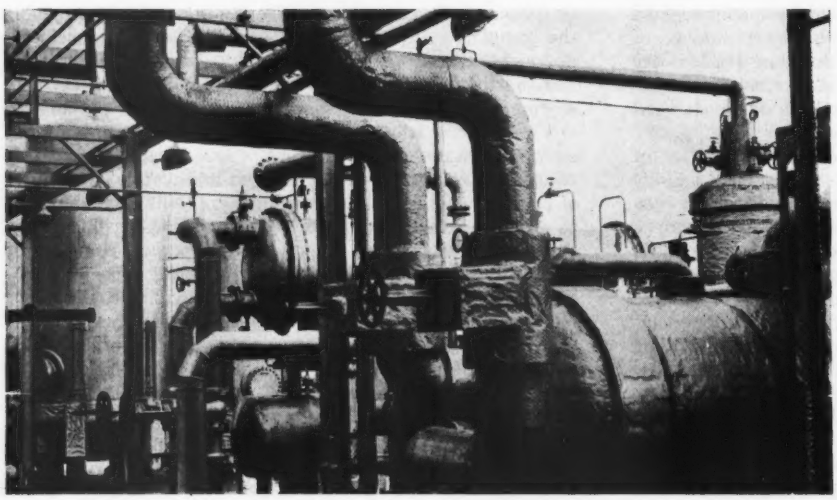
The Vybak range of extrusion and injection moulding compounds are well known and cover all British Standards and Government specifications. They are used, for example, for the coating of electric cables, telephone, radio and car wiring, motor-car wing piping, garden hose and belts. The newest of these materials, which are of growing importance, are those used for the production of flexible injection moulded components which are finding increasing use in various applications in industrial and domestic markets. Rigid extrusions for chemical piping and similar purposes are produced from other compositions and compounds are also supplied for the manufacture of long-playing gramophone records.

Calendered sheeting, which is otherwise used for handbags, wallets and similar purposes, is used as the intermediate form for the manufacture of press-polished sheeting.

These press-polished products are of particular interest, and Bakelite Limited has been a pioneer in this country in the production of glass-clear sheets, both flexible and rigid, which are being supplied in increasing quantities to the motor trade. The rigid sheets are used as sidescreens and the flexible for rear windows in drop-head coupés. For the latter purpose they have the advantage that they do not yellow with age, and also that they fold with the hood, thus making possible the use of larger rear windows and improving the rear view.

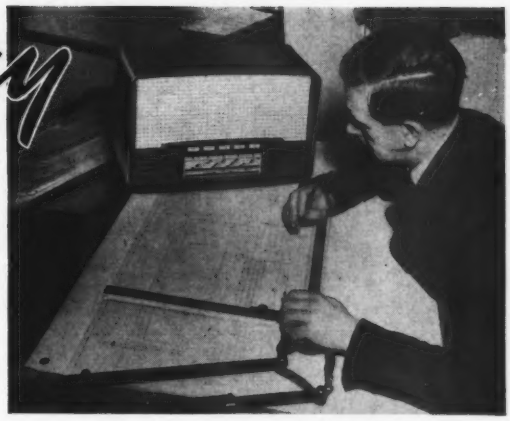
Within the last year or two there has been an increasing awareness in this country of the importance of polyvinyl chloride rigid sheet as a material of construction for chemical and allied plant. Techniques for the use of this material have been known and used on the Continent for some time. Bakelite Limited produce a rigid sheet suitable for this work. It is inert to most acids and alkalis and can be fabricated using relatively simple equipment.

In addition to the production plant at Aycliffe and the extentive testing facilities, there are well-equipped research and development laboratories, the staff working closely with the works' technical staff. Fundamental research is, however, carried out at the company's research department at Tyseley, Birmingham. A nucleus of expert personnel was introduced from the company's main works at Birmingham and has settled happily in the area. A much larger number have been recruited locally, and more than 500 people are now employed at the Aycliffe Works.



The storage and refrigeration plant seen here is adjacent to the polymerization plant. This section is built "in the open," that is without any walled or roofed structure.

Production Story



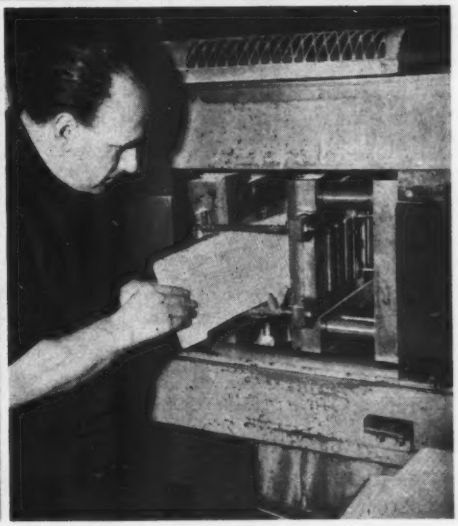
E. K. Cole Ltd. is perhaps best known in the radio, television and electronic fields. The company's plastics division is however one of the largest moulding units in the country, employing upwards of 700 people, and with compression press capacities ranging from 10 to 2,000 tons and injection press capacities from 1½ to 48-oz. This article describes briefly the steps in the manufacture of a radio cabinet from the drawing-board stage, one product of a division which now sells 85% of its mouldings to outside organizations, making it one of the biggest custom moulders in the country.

THE transformation of an idea into a finished moulding is a process which to the uninitiated appears simple: perhaps the continuous production nature of the plastics industry encourages this misconception. Certainly it is a fact that mass production enables a prototype to be multiplied to order, but the thought and planning that is necessary to achieve this is the opposite of simple and the notes which follow may help to explain to the customers of the plastics industry the sequence of operations that follows the customer's first consultation with the moulder.

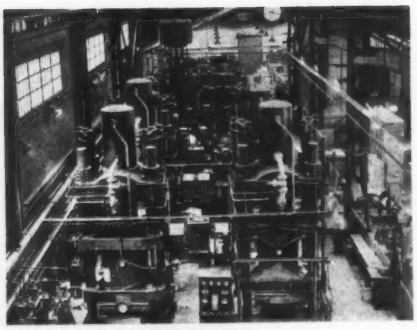
The customer will raise a number of questions during his preliminary discussions; how much will the job cost, what material should be used, will this material withstand the conditions it will have to work under, is it light, stable, are the electrical properties good? These are typical of the many questions which may be raised.

The system of costing employed by the Plastics Division is in essence similar to that used by other large organizations. By consultation with the various departments involved, and with the aid of skilled estimators, the price is arrived at for a suitable quantity.

Ownership of tools is a question which is frequently asked of the moulder. When the tool is made specially for the mouldings to be sold to the customer, and is made entirely or partly by the moulder, it remains the property of the moulder even if the customer has been debited with part of the cost. The moulder keeps such tools in good repair and will not use them for any other purpose.



(Above, left) Drawing office. (Above. right) Tool inspection. (Below, left) Thermoplastics shop. (Below, right) Removal of grille from press.



(Right) View of large presses in thermosetting mould shop.

(Left) Compressed air cleans the tool for radio cabinet.

(Right) 1,600-ton press for radio cabinet, and preheating oven.

(Left) Removal of major flash with aid of files.

(Right) Addition of decorative markings.

For most industrial purposes the configuration of a moulding is governed by the job it has to do. The problem is, therefore, reduced to a discussion between moulder and user, the main point of which is to overcome any technical difficulties which may exist in actually moulding the job in hand and methods of obtaining the maximum advantage from plastics.

In the case of many other mouldings however, an element of original design exists and it is here that the moulder can be of great assistance to the customer. He, better than most, understands the potentialities as well as the limitations of the various plastics materials he has available. He is, therefore, in a position to give helpful advice to the customer as to the selection of the right material for the job. In addition, although complex shapes are by no means rare in plastics mouldings, it is as well to draw the customer's attention to the fact that the more complicated the shape the greater the tool price will be.

There are a number of moulders who maintain a design department, the function of which is essentially creative. At an early stage in the negotiations, the customer's ideas and sketches will be brought to the attention of the design department, which will proceed to prepare a series of specimen drawings. For the purpose of this article we have selected a radio set and it will be seen from the illustrations that the design department were responsible not only for the preparation of specimen drawings but also for the manufacture of a wooden prototype, specially finished to simulate as closely as possible the appearance of the moulded production. From colour drawings and such prototypes a final choice was made, although it should be understood that even at this stage the technical experts were in consultation to ensure that the manufacture of the accepted design was possible.

Following agreement between the customer and the moulder as to the shape required, the sketches were passed to the drawing office. Here the draughtsmen were concerned with the translation of the embryo idea into a series of working drawings from which the appropriate tools could be made. Sets of drawings were prepared to form the basis for further consultation within the company between the various departments concerned, relating the dimensions of the various items required to be moulded with the press capacities available. In this particular case two basic mouldings were required, the cabinet which was to be produced from a phenolic material simulating a grained walnut effect, and a thermoplastic grille. Both thermosetting and thermoplastic departments were therefore concerned.

After the acceptance of the working drawings, the toolroom received instructions to go ahead. The modern toolroom must be equipped with every kind of machine, ranging from the Keller profile-milling machine to the toolmaker's lathe. The manufacture of large-scale tools is a lengthy and costly business and all the skill of the organization is brought into play at this stage. All tools are subjected to rigid inspection by a separate department which is equipped with the latest apparatus. The tools for the cabinet, having satisfied the inspectorate, were passed to the moulding shops.

At this point the production flow split into two channels, one being routed through the thermoplastic shop, the other through the thermosetting shop. Into the former went the

FLOW SHEET FOR

DESIGN → ESTIMATING → TOOL DESIGN → TOOL MAKING → TOOL INSPECTION → THERMOPLASTIC PRESS SHOP FOR SAMPLE MOULDINGS → SAMPLES CHECKED WITH COMPONENT DRAWINGS

DESIGN → ESTIMATING → TOOL DESIGN → TOOL MAKING → TOOL INSPECTION → THERMOSETTING PRESS SHOP FOR SAMPLE MOULDINGS → SAMPLES CHECKED WITH COMPONENT DRAWINGS

tools for the grille. Depending upon the arrangements which had been made in advance, a particular press was available and after the necessary trial runs production commenced. By careful planning the minimum of finish was required to the moulded unit. Each unit was inspected after polishing and then moved over to the assembly shop, where it would finally take its place in the completed radio.

The tools for the cabinet proper were, in the meanwhile, installed in one of the largest presses available, having a capacity of 1,600 tons. This press, of the down-stroking variety, had adjacent to it a weighing table and a pre-heating oven. Whilst one cabinet was curing in the press, powder for the next was being pre-heated to the required temperature.

The press operated on a three-minute time cycle. Flash relief was incorporated on the actual face of the cabinet, which constituted that part which was on the bottom of the mould cabinet. It was thus a simple matter to break away the thin flash which masks this flash relief, thus making space for the grille and the various other holes called for in the design. The operator removed the major flash, after which the mouldings were passed to the head of a lengthy finishing line staffed mainly by female labour.

The first operation was to file out the frets, which were afterwards gauged for size by means of a simple tool. Next, the large areas on which the flash occurs were trimmed. This was followed by drilling out holes on the inside of the cabinet for the fixing of the chassis and other equipment. At all of these stages jigs were used, usually fabricated from Tufnol, since, due to the lightness, they greatly facilitate the accurate positioning of the moulding for each process and simplify the task of the various operatives. They also prevent scratching the component.

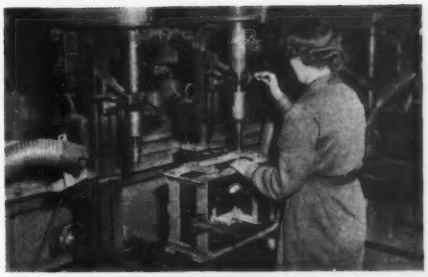
For the machining of phenolic materials, particularly drilling, special techniques are called for and the use of specially modified drill bits is desirable.

At intervals down the finishing line the mouldings were inspected for accuracy of finish and the operation was concluded by the employment of a series of buffs the purpose of which were to impart a high polish to the mouldings as a whole and to polish away the marks left by flash removal, drilling, etc.

Subject to the finished moulding passing the necessary final inspection, it was then transferred to the radio assembly line, there to await the arrival of the completed chassis.

The final stage was to have the set polished, after incorporation of the chassis, when it was ready for dispatch.

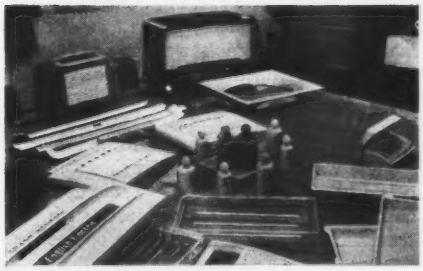
The foregoing notes are designed to illustrate the forethought and planning which is today an inherent part of the economic mass production of high-quality moulded units. At each stage the specialists involved are invited to state their views in order that the technical skill of the organization as a whole may be used to the advantage of all concerned, particularly the customer. By consideration of the customer's wishes, by sensible guidance in the use of materials, a product can be achieved which will reflect creditably upon the customer, the moulder and the plastics industry as a whole, and it should therefore be self-evident that the preliminary work on the part of designers and technologists is of the greatest value to this end.



(Left) Drilling with the aid of aluminium jigs.

(Right) Screwing-in chassis at end of radio assembly line.

(Left) Radio ready for packing and dispatch.



(Right) Examples of some larger mouldings of E. K. Cole's plastics division.

(Left) Some small custom mouldings from the wide range of products.

PRODUCTION OF RADIO CABINET

ON RECEIPT OF APPROVAL OF SAMPLES FROM CUSTOMER → COMMENCEMENT OF PRODUCTION → INSPECTION → FINISHING → INSPECTION OF FINISHING → RADIO ASSEMBLY

ON RECEIPT OF APPROVAL OF SAMPLES FROM CUSTOMER → COMMENCEMENT OF PRODUCTION → INSPECTION OF UNFINISHED MOULDINGS → FINISHING LINE → FINAL INSPECTION → RADIO ASSEMBLY

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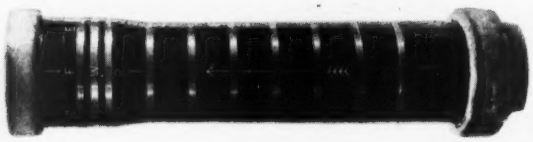


(Above) 4-in. diameter carrier for pre-selector pneumatic tube system. Metallic contact bands are accurately located on the phenolic resin bonded paper laminate tube. (Left) An operator inserts a pre-selector carrier into the tube circuit. Another carrier is seen in the delivery chute.

Many plastics materials help to improve the efficiency of pneumatic tube conveyor systems.

PLASTICS FOR LAMSON TUBES

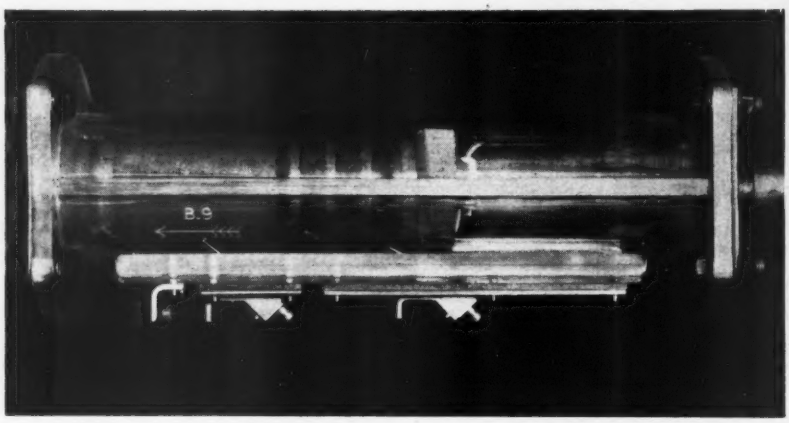
PNEUMATIC tube conveyor systems have been used for many years in large stores, offices and factories to provide a simple and rapid means of conveying messages, money, documents, test samples and objects from one part of an organization to another. Probably the best known example is that of large shops and department stores in which all money received is conveyed from various points by pneumatic tubes to a central cash desk, receipts and change being returned in the same way. The Lamson Engineering Co., Ltd., Hythe Road, Willesden, London, N.W.10, have developed such pneumatic tube systems during the course of many years, and, together with their associated companies in America, France, Belgium and Australia, etc., they are now the largest company in the world manufacturing this type of equipment. Development during the course of many years has provided the knowledge and experience enabling modern installations to distribute carriers rapidly through very complex networks. Such improvements have in recent years, taken full advantage of plastics materials and the properties which they can impart to different components.

Pre-selector Systems

Whereas early Lamson installations, and many which are still produced and used today have a separate set of tubes connecting any two stations, great improvement in the efficiency and complexity of operation has been brought about by the introduction of a pre-selector system. Carriers can be introduced into the circuit at any station, they can then be routed into one of a number of channels and ejected at a station determined by the pre-selector rings on the carrier. The deflection is actuated by the electric circuit which is momentarily completed as the spacing of two contact rings on the carrier passes the spaced brushes on the station selector.

A carrier of the type used in such a system is shown at the head of this page. The main part is fabricated from a paper base phenolic resin bonded laminated tube. This material supplied by Ioco, Ltd., of Glasgow, was selected principally for its excellent electrical properties which are essential to carry the sensitive currents operating the deflector doors. The laminated tube is also capable of very accurate machining so that the metallic contacts, spacers, etc., can be located to very close tolerances. The hinged cap of the carrier is fabricated from another plastics laminate made by Ioco Ltd., a fabric base material being selected for this purpose.

Metallic contact strips are accurately located along the length of the carrier. By combining series of these bands through rotation of the pre-selector control ring any one of the stations can be selected. As carriers pass the appropriate control point the two bands complete an electronic circuit which controls the mechanism deflecting the carrier. So that the passage of carriers through



A Lamson pre-selector carrier passing through a station selector section of the tube. To check the operation of the selector this part of the tube is fabricated from transparent Perspex.

(Right) Carriers fabricated from transparent cellulose acetate extruded tubing enable the contents to be seen at a glance.

control points can be checked and observed certain lengths of tubing are replaced by transparent Perspex. These include the station selectors holding the contact brushes. These parts are fabricated for the Lamson Engineering Co., Ltd., by Triplex Safety Glass Co., Ltd.

Transparent cellulose acetate extruded by BX Plastics, Ltd., is also used to manufacture carriers where it is an advantage to see the contents immediately on arrival. The plastic material is also tough and durable and gives a long service life.

Wire-reinforced cellulose acetate sheeting, manufactured by British Celanese, Ltd., under the trade name "Wireweld," is used in the fabrication of large carriers suitable for conveying complete document files. Installations of this size are in operation in Government offices in London.

The Lamson tube system is frequently used in factories for sending control samples from a production department to test laboratories, such as in the preparation of metal alloys where a test piece is analysed before ingots are poured and in paper-making where the cellulose pulp is tested at the beater stage before the batch is approved for production. At one large paper mill a special screw-top container has been injection moulded from polythene to take the acid beater mixture in a pneumatic tube carrier to the production control laboratory.

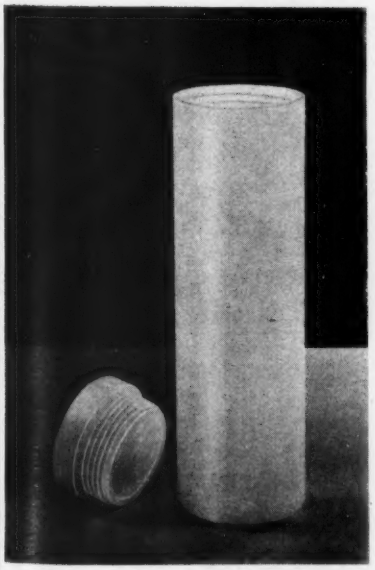
All-plastics Tube Installations

The advantage of being able to see the operation of the whole conveyor system has led to the installation of at least one tube system made entirely from extruded cellulose acetate tubing, of 1-in. diameter. This is in operation at the National Signals Centre, Croydon, Surrey, and is used for sending tickertape messages to different offices. The carriers used in this installation are not of the normal tube type but merely provide a clip for the tape. The advantage of transparency is obvious since any messages which get lost in the tube are easily seen and can be recovered without much trouble.

British Railways, Ltd., have for many years now used a pneumatic tube system at their Fleetwood marshalling yard. This was first installed before the war using extruded Rockite phenolic tubing which is now supplied by British Resin Products, Ltd. The installation, which employs several 100 ft. of plastic tubing, has given excellent service throughout its life, requiring very little maintenance. The main disadvantage of the material is a certain brittleness which may prevent its use in situations where mechanical shocks are likely to be encountered.

Other all-plastics tubes are now under investigation and Lamson Engineering Co., Ltd., have shown great interest in the growing production of rigid thermoplastic extrusions.

Being strong, light in weight and non-corrosive, rigid p.v.c. tubes appear to offer many advantages over the steel tubes currently employed in the standard Lamson installation. Being a thermoplastic material, however, there are certain limitations to its general use. For example, it is not possible to employ long tubes in locations where the temperature might rise above 50 to 60° C., since the rigidity of unplasticized p.v.c. begins to be affected above this temperature. The slight flexibility presents another difficulty in that long lengths of tube must be supported either continuously or at fairly small intervals whereas the equivalent metal pipes can stand unsupported over long distances.

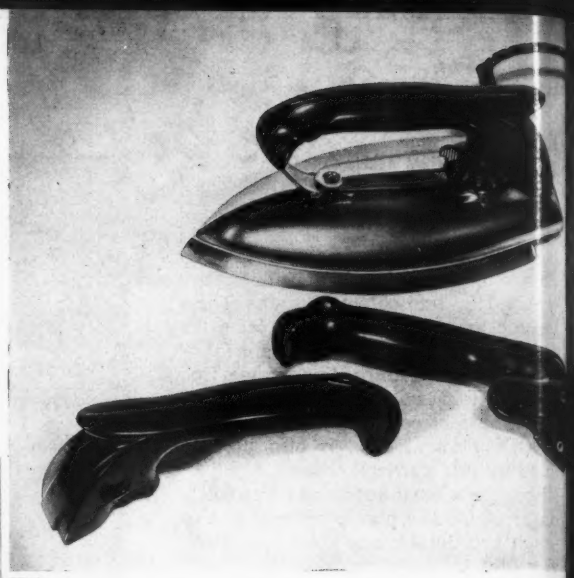


(Left) A moulded acid-resisting polythene container carrying paper pulp samples for testing is conveyed by Lamson tube from the beater to the test laboratory. (Right) Complete document files can be sent in this large carrier fabricated from transparent wire-reinforced cellulose acetate.

PLASTICS
IN THE SERVICE OF MAN

A pictorial review of high-quality units moulded or otherwise fabricated in Great Britain . . .

44. Electrical Household Appliances—2

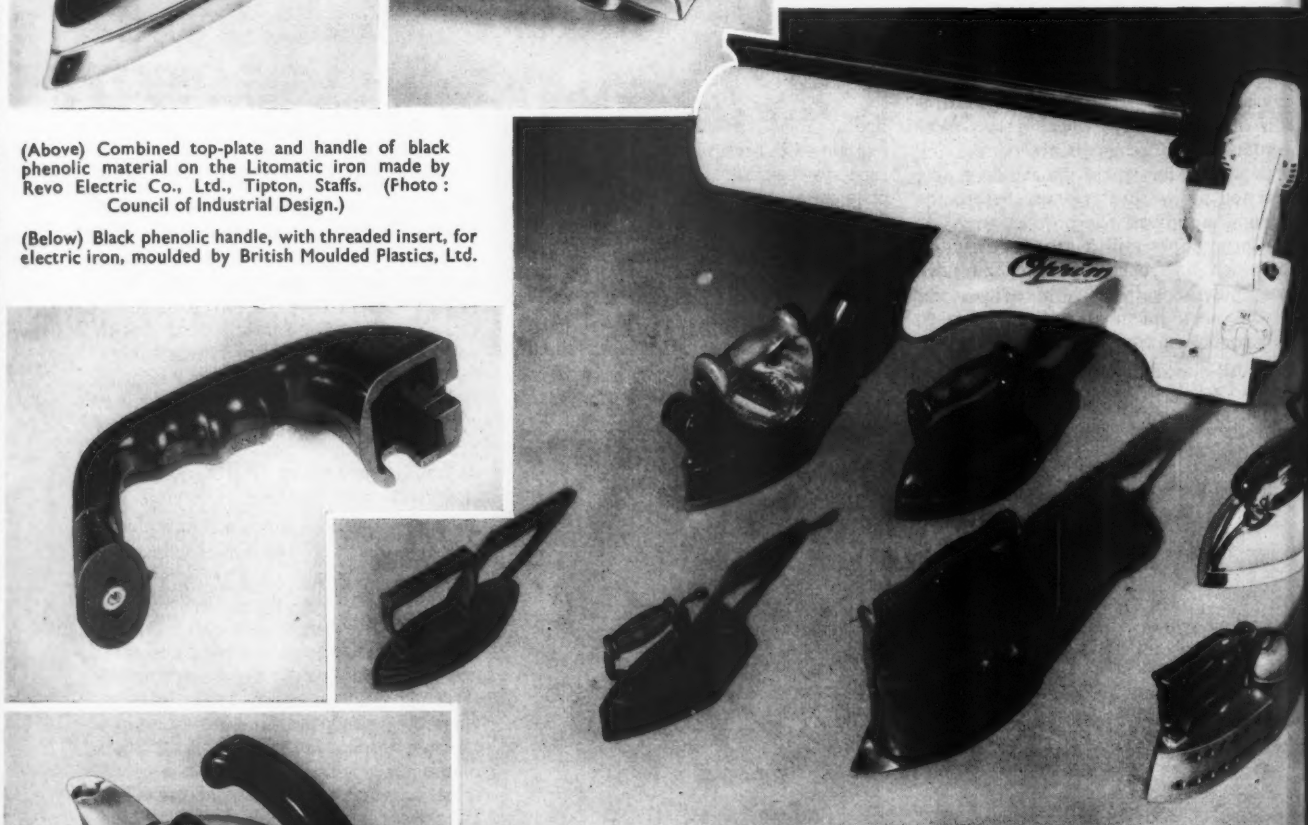


(Above) Thermostatically-controlled electric iron made by L. G. Hawkins and Co., Ltd., employs phenolic handles made by Kent Mouldings.

(Left) Handle of the Creda "Halo" iron is moulded in black phenolic by United Ebonite and Lorival, Ltd.

(Above) Combined top-plate and handle of black phenolic material on the Litomatic iron made by Revo Electric Co., Ltd., Tipton, Staffs. (Photo: Council of Industrial Design.)

(Below) Black phenolic handle, with threaded insert, for electric iron, moulded by British Moulded Plastics, Ltd.



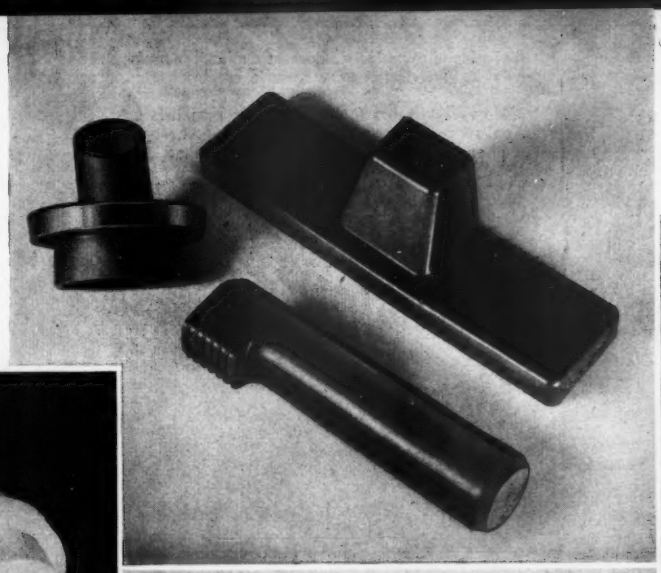
(Above) Evolution of the domestic iron from the 18th century. Contemporary flat iron (L. G. Hawkins and Co., Ltd.) and rotary presser (Oprim) employ plastic knobs, switches and handles. (Photo: Council of Industrial Design).

(Left) Creda kettle with handles of kettle and lid moulded in phenolic by United Ebonite and Lorival, Ltd.

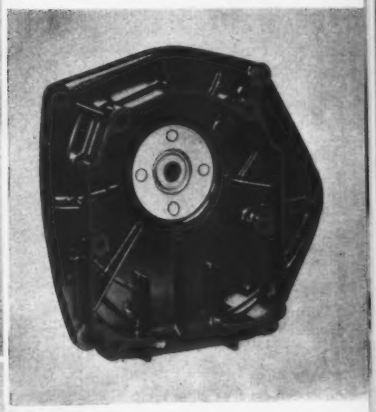
(Right) Systym electric iron with heat control has black Bakelite phenolic handle moulded by the manufacturers, General Automatic Iron, Ltd. (Photo: Council of Industrial Design.)

(Right) Oval and rectangular brush holders and handle for the Vactric suction sweeper, injection-moulded from flexible p.v.c. by British Moulded Plastics, Ltd.

(Below) Nylon wringer bearings requiring no oil lubrication are seen here attached to the moulding sprue; made by British Moulded Plastics, Ltd., for Hotpoint Electrical Appliance Co., Ltd.

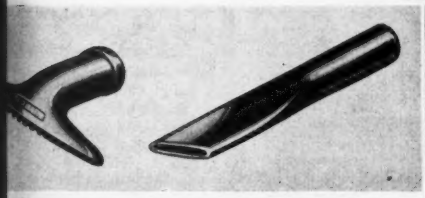


(Below) Part of the motor case of of the Hoover 612 cleaner moulded in Bakelite phenolic material by Hoover, Ltd.



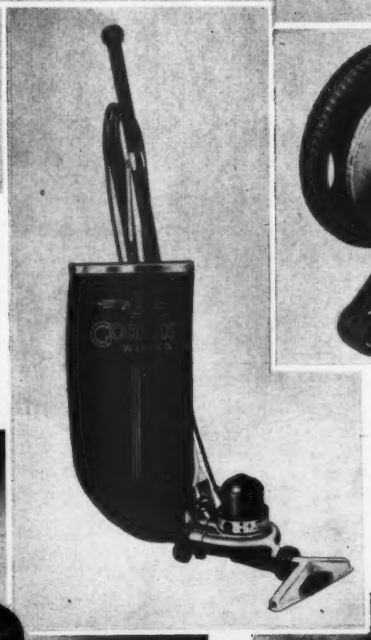
(Below) Accessories for Goblin cleaners made by British Vacuum Cleaner and Engineering Co., Ltd., include a Bakelite upholstery tool moulded by Stadium, Ltd., and a crevice tool fabricated from rigid p.v.c. tube, supplied by Tannoid, Ltd.

(Left) Motor hood (incorporating lamp housing), of Hoover 612 cleaner. moulded in shock-resisting phenolic material by Hoover, Ltd. (Below) Pulsator of the Hoover Washing Machine Mark II is moulded with special accuracy from heat- and water-resisting material.



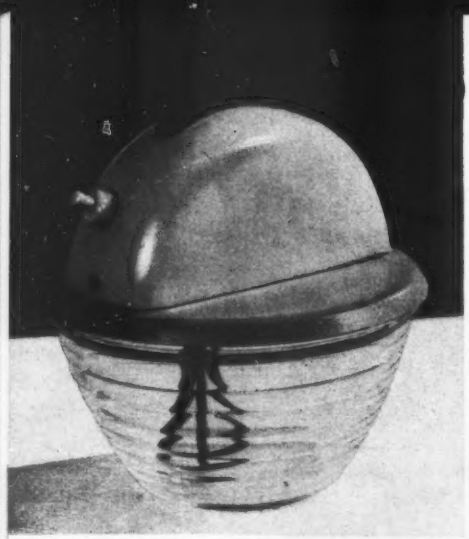
(Right) Plastic components of the Goblin Wizard, made by British Vacuum Cleaner and Engineering Co., Ltd., include motor cover and plate, wheels, agitator plate, in phenolic material and handle grip in cellulose acetate.

(Below) Combined vacuum cleaner and floor polisher made by Vactric, Ltd., employs phenolic motor cover and p.v.c. bumper.

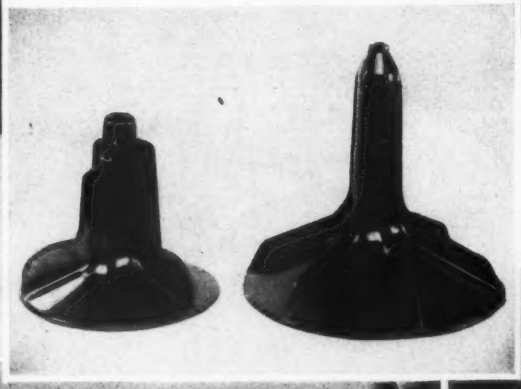


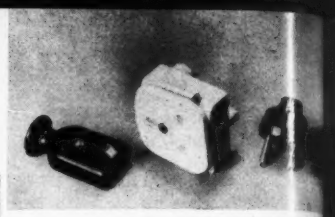
(Above) Pump assembly components of Hoover Washing Machine Mark II are moulded by Hoover, Ltd., from heat-resisting, low water absorption phenolic.

(Below) Goblin G29 cleaner, by British Vacuum Cleaner and Engineering Co., Ltd., incorporates hose connector, inlet sleeves, hose inlet, exhaust outlet and crystal holder moulded in phenolic by Stadium, Ltd.

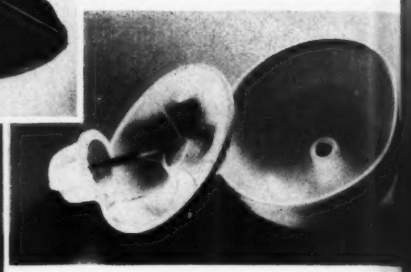


(Left) Handimix electric domestic mixer, manufactured by K.K. Electrical Products, has a cream plastic motor housing.
(Below) Agitators for two washing machines by Thor Appliances Ltd. are moulded in water- and heat-resisting phenolic material by British Moulded Plastics, Ltd.

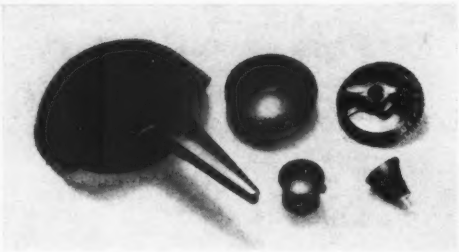




(Above) Phenolic and urea mouldings are produced by Nettle Accessories Ltd. for use in their accessories for electrical appliances.

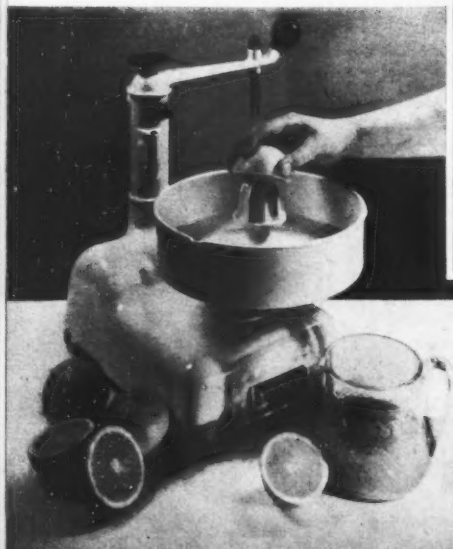


(Right) Heating elements incorporated in Holoplast laminated plastics panels provide skirting board heating; manufactured by Unity Heating Ltd.



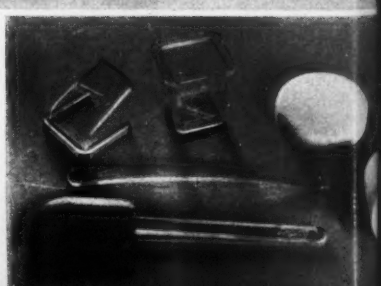
(Above, left and below) By means of interchangeable components the Kenwood food mixer (below) can be used for many purposes; fruit juice extractor components (above) are moulded in urea by London Moulders Ltd.; (left) cover plate and cover for mincer in black Nestorite phenolic by Ray Mouldings Ltd., knobs and switches in black Bakelite phenolic by London Moulders Ltd.

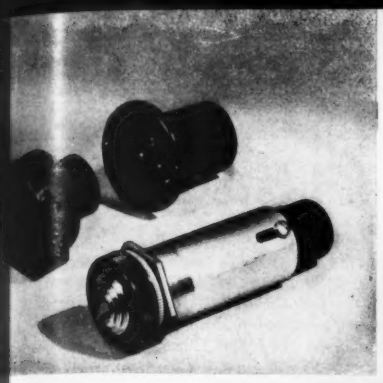
(Above) The curved moulded handles of "The Elecooker" radiant heat cooker, manufactured by Champion Electric Corporation, Seaford, are designed to form a rack for warming plates.



(Right) Further components of the Kenwood mixer (above) include two transparent Diakon scrapers and a urea cap, moulded by British Artid Plastics Ltd. and two transparent polystyrene parts and a white urea cap made by London Moulders Ltd.

(Left) Plastics components of the Lammix food mixer manufactured by Huwood Components include resin bonded laminate gears made by The Bushing Co. Ltd.

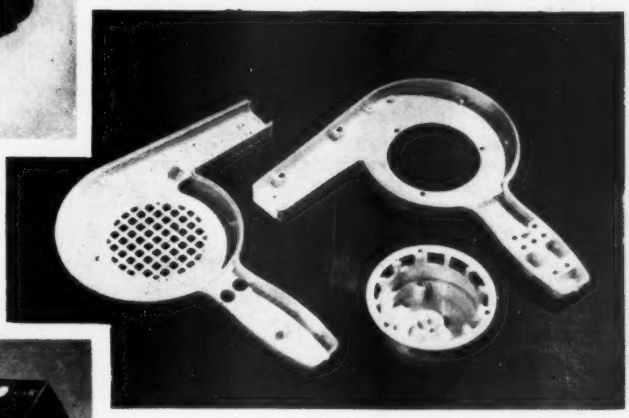


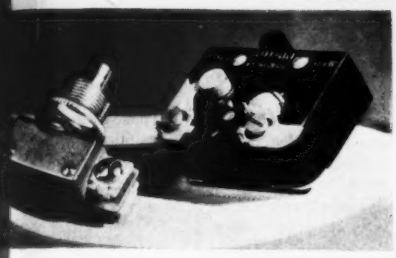


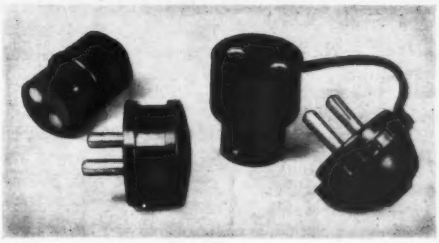
(Above and below) Plastics mouldings and laminates are employed in connectors, pilot indicator lamps, switches and other electrical components made by A. F. Bulgin and Co., Ltd.

(Right) Coffee percolator made by H.M.V. Household Appliances has black Bakelite phenolic handle and base.

(Below) Mouldings made by Crystalate, Ltd., in Beetle urea form the housing of the Sylentflo hair dryer manufactured by Fractional H.P. Motors, Ltd. (Photo : British Industrial Plastics, Ltd.)



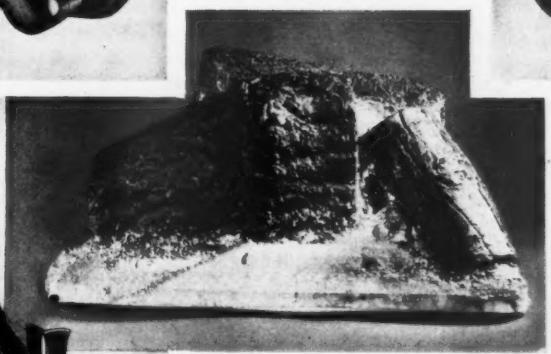




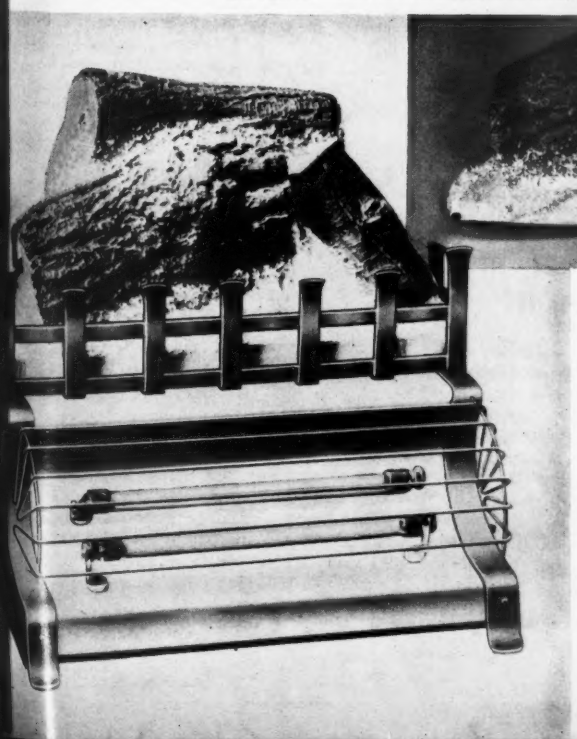
(Left) Pin-type and bayonet-type plugs and connectors, moulded by Ranton and Co., Ltd., are used in many appliances.

(Right) Urea and phenolic mouldings for the New Day range of electrical components are made by Resinoid and Mica Products, Ltd., for New Day Electrical Accessories, Ltd.

(Right) Flexible p.v.c. mouldings are made for Hoover suction cleaners by J. F. Kenure, Ltd.



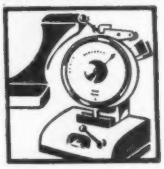
(Below) This prototype model of a washing machine by H. Fisher (Oldham), Ltd., shows the use of Holoplast laminated plastics panels for the cabinet. (Photo : Council of Industrial Design.)



(Above and left) Melton electric fires, manufactured by the Reinforced Plastics Co., Leicester, incorporate glass fibre reinforced polyester mouldings shaped and coloured to simulate a burning log or coal fire.

World's Industry Employs Plastics

MATERIALS and TESTING



Non-inflammable glass fibre laminates.—Phthalic anhydride-based polyester resin laminates are particularly susceptible to flames. Excellent non-flam properties have been obtained by Hooker Electrochemical Co. by using chlorinated compounds as a polyester base. The diene adduct of hexachlorocyclopentadiene with maleic acid can be a constituent (up to 50%) of unsaturated polyester. Laminates of new resin ⅛ in. thick burn at 1/12 rate of phthalic acid-based laminates of same thickness. With 3% antimony oxide added laminates do not ignite under A.S.T.M. conditions.
(*Ind. and Eng. Chemistry*, 1953/Nov./13A.)

Synthetic rubber modifications.—K. Rose surveys recent modifications during production of the familiar synthetic rubbers.
(*Materials and Methods*, 1953/Sep./108.)

Hardness testing of plastics.—The A.S.T.M. committee D-20 intends to arrange for comparative studies of the British Admiralty hardness test with comparable A.S.T.M. hardness tests, methods for evaluating scratch resistance and specifications for modified polystyrene plastics.
(*A.S.T.M. Bulletin*, 1953/Sep./13.)

Strain stiffness tester for thin films.—A known strain is quickly applied to an annular specimen. The load required to maintain this strain is measured through a commercial strain-gauge bridge. From this load and the strain, a modulus can be calculated.
(*A.S.T.M. Bulletin*, 1953/Sep./40.)

Detergency of hard surfaces.—A simple test has been developed for determining the efficiency of detergents in cleaning a wide variety of surfaces, including glass, steel and nylon substrates. Clean and soiled substrates are agitated in a Launderometer and a single operation permits rating of detersive efficiency, soil redeposition and soil suspending action of detergent.
(*A.S.T.M. Bulletin*, 1953/Sep./49.)

Modified phenolic resins have been prepared by condensing cashew nut shell liquid or bhilawan nut shell liquid. The properties of oil varnishes prepared from them have been investigated.
(*Journal Sci. and Ind. Research* (New Delhi), 1953/Sep./411.)

Dielectric properties of phenol-formaldehyde.—A technical report on this subject with plates, tables and bibliography has recently been written by E. Rushton.
(*Brit. Electrical and Allied Ind. Research Assn.*, Techn. Report, Series L/T273.)

Physical properties of Perlon.—H. Boehringer reports on the changes in the properties of Perlon polyamide fibres under the influence of prestraining, temperature, moisture and stress.
(*Textil Praxis*, 1953/Sept./745.)

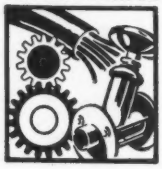
Polystyrene injection-moulding materials.—The German Standards Committee has developed a draft standard for these materials, specifying minimum requirements and tests.
(*DIN-Mitteilungen*, 1953/Oct. 1/302.)

Polymethylstyrene.—Polymers of methyl styrene and dimethyl styrene have high heat-distortion temperatures (resistant to boiling water). American Cyanamid Co. have developed an economic preparation method which avoids use of benzene.
(*Ind. and Eng. Chemistry*, 1953/Nov./17A.)

Corrosion due to plastics under gamma radiation.—Bushings, gaskets, etc., made of p.v.c. and p.t.f.c.e. (trichlorofluoroethylene) evolve chlorine and fluorine when exposed to gamma radiation from radio-active materials.
(*Ind. and Eng. Chemistry*, 1953/Nov./2549.)

Review of recently developed materials.—A list comprises 171 items, among them 18 new plastics, finishes, lacquers, primers, etc.
(*Machinery* (New York), 1953/Oct./169.)

INDUSTRIAL APPLICATIONS



New vinyl-metal sheet.—In a process of Naugatuck Chemical Div. of U.S. Rubber Co. semi-rigid vinyl film is bonded rigidly to steel and aluminium sheets. The laminate has the strength of the base metal and high wear and corrosion resistance.
(*Materials and Methods*, 1953/Sep./94.)

Plastics in the foundry.—G. Cenin surveys the application of plastics for the production of cores and the improvement of foundry sands.
(*Revue Gen. de Mécanique*, 1953/Oct./375.)

Wrapping in plastic foils.—F. Ohl surveys the possibilities foils of various thermoplastics give as wrapping of metals, in particular as protection against corrosion.
(*Metalloberfläche*, 1953/Nov./A169.)

Fixtures with plastic fillers.—Z. Martinek describes the use of clamping devices for machine tools, in particular lathes using a hydro-plastic material.
(*Machinery* (Hungary) Gep., 1953/Jan./9.)

Silicones for the motorcar.—Recent developments by Dow Corning laboratories may become useful for motorcars.
(*Automotive Industries*, 1953/Nov. 1/113.)

PROCESSES : MACHINERY

Hot forming and welding of thermoplastics.—O. Dammer gives an up-to-date survey of the characteristic properties of thermoplastics which make them suitable for hot forming and welding. Semi-finished products such as tubes, profiles, sheets and foils are discussed.
(*Kunststoffe*, 1953/Sep./330.)

Injection moulding.—At a Plastics Symposium, July, 1953, in Essen, W. Laeis gave a survey on machines, materials, and gave general recommendations for the design of injection-moulded parts.
(*Kunststoffe*, 1953/Sep./336.)

Injection moulds.—H. Gastrow, one of the pioneers in automatic injection-moulding machines, discusses the design, elements and the selection of tool materials.
(*Kunststoffe*, 1953/Sep./365.)

Printing on plastics.—A new process has been developed by Homalite Corp., 11-13 Brookside Drive, Wilmington 166, Delaware, for making lines, scales and figures on plastics. Lines can be made as thin as 0.007 in.
(*Instrument Manufacturing*, 1953/May/June/97.)

Production technique for plastic bodies.—J. Geschelin reviews the production technique of plastic bodies for the Chevrolet Corvette, of which 12,000 are to be produced during 1954.
(*Automotive Industries*, 1953/Nov. 1/70.)

Sintering methods for corrosion-resistant plastic films.—E. Gemmer gives a survey of three powder sintering methods for the application of polyethylene: (1) the dipping method, (2) the rolling method, and (3) the whirl-sintering method.
(*Industrie Anzeiger*, 1953/Oct. 23/1095.)

Joining Teflon.—H. G. Henry describes in detail the new fusion-bonding process. With proper combination of temperature, pressure and time, this difficult-to-join material is said to be readily welded.
(*Materials and Methods*, 1953/Oct./114.)

MISCELLANEOUS USES

Elastomer impregnated leather.—Performance tests on Conpor indicate that a porosity control has been accomplished. This is the most desirable property for leather-sealing members, i.e. to permit lubrication through the seal itself.
(*Materials and Methods*, 1953/Oct./127.)

Urea-formaldehyde resins for bookbinding and bookcases.—An investigation was made to find out the possibility of protecting books for many years against insect attacks. For first six months the treatment was toxic to all insects coming in contact with the books or shelves. Protection for some years is expected.
(*Journal of Documentation*, 1953/Sep./157.)

Large mouldings of thermosetting resins.—In West Germany at present five times as many components are made of thermosetting than of thermoplastic resins. The special design requirements of large moulded parts, in particular radio cabinets, are discussed.
(*Kunststoffe*, 1953/Sep./341.)

EIGHTH SWEDISH PLASTICS CONFERENCE

Summaries of Papers read by British Delegates in Stockholm, November, 1953, and some photographs of Swedish plant and productions.

THAT the Swedish plastics industry is very much of a positive factor of Sweden's industrial life was fully evidenced by the interest displayed in the Plastics Conference held in Stockholm in November. Apart from the very large number of visitors from overseas, over 350 members of the Swedish industry attended to hear the various papers being read and to take part in the discussions which followed. The organization and management of a conference of this nature is by no means an easy task and great credit is due to Mr. J. E. Janson, Secretary of the Swedish Federation, and to his staff, for the admirable way in which the Conference was run.

To the British visitor one of the most striking points was the obvious avidity with which Sweden has absorbed ideas and developments from abroad. Some of the photographs shown on these pages demonstrate the ability of the Swedes to make good use of British materials and machines. In the course of visiting two of Sweden's largest moulding shops, the writer was able to see injection machines from three different British companies in use, and obviously highly thought of by their owners.

Sweden is traditionally a hospitable country and of all the Swedish cities, Stockholm is probably the loveliest in which to hold a conference, the purpose of which is not only to spread technical knowledge but also to cement the bonds of friendship between the various plastics industries of the world. The British delegation, led by Mr. Cyril Dingley, was entertained in a lavish manner and no effort was spared to secure for them entry into Swedish plants which might be of interest.

The papers read were grouped together where possible to form a complete morning or afternoon session, so that the visitor, whether from abroad or from Sweden itself, could, if necessary, attend only that session which was of particular interest to him. It was interesting to note how various topics were held to be of greater importance than others by the numbers which attended the various sessions. For example, a very large number attended the series of papers which dealt with glass-fibre reinforced plastics and polyester resins.

The work of the Conference itself was admirably interspersed by various functions organized by the Swedish Federation, including a banquet on the day on which the Conference opened and a luncheon on the day following. The British delegates were invited to a cocktail party at the home of Mr. Harry Nystrom and on another evening to a party at the home of Mr. Janson. These functions served very well to bring together people of various nationalities having similar fields of interest.

Twenty-six papers were read, and short summaries of those contributed by the British delegates are published herewith.

Some Essential Points in the Design of Transfer Moulds

J. Butler, British Industrial Plastics, Ltd.

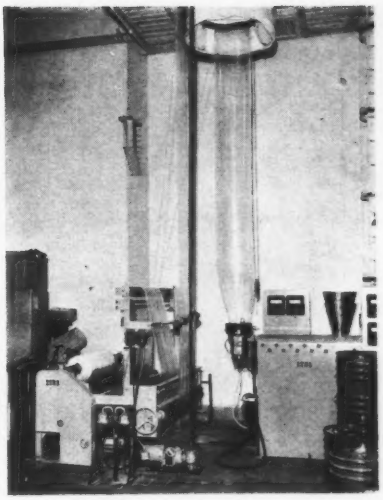
THIS paper dealt with those aspects of transfer moulds and moulding about which there still remains some mystery, namely frictional heat, the hydraulic theory, certain aspects of split moulds and the strength of transfer mouldings. By defining where frictional heat was generated in a charge it was possible more clearly to define its effects and to attempt to avoid the bad ones. The heat generated within the feed system adjacent to the outer skin, was allowed to stay in the zone in which it was generated without being lost to the mould or being shared with the bulk of the charge; the latter was the snag. Until means could be found to reap the advantage from frictional heat it was necessary to avoid or reduce frictional heat to the minimum, by using large section areas of feeds and comparatively low transfer pressures.

Hydraulic theory was the term used to describe the balance of transfer and clamping pressures. By using deep relief on moulds, coupled with large section feeds, greater areas of moulding could be used in a given mould than would otherwise be the case.

A method was described of finding the most suitable angle of tapered split moulds to give the maximum area of cavity that could be moulded under given conditions.

The low impact strength of transfer mouldings made from the stronger materials had been a problem but by using a feed system large in section and by careful placing of gates strong mouldings from shock-proof materials were being made.

Finally, it was emphasized that experience had shown that most of the troubles in transfer moulding were due to restricted feed systems. Mr. Butler gave these warnings:—(1) avoid feeding in the plain surface of a moulding or warping would result, (2) use reasonable feed sections to control material shrinkage, (3) make runners round or square and not flat, (4) concentrate on runners rather than gates if starvation of the moulding is occurring, (5) avoid long runners and "long" gates, (6) avoid feeding on one side of a moulding having a greater length than its other dimensions.

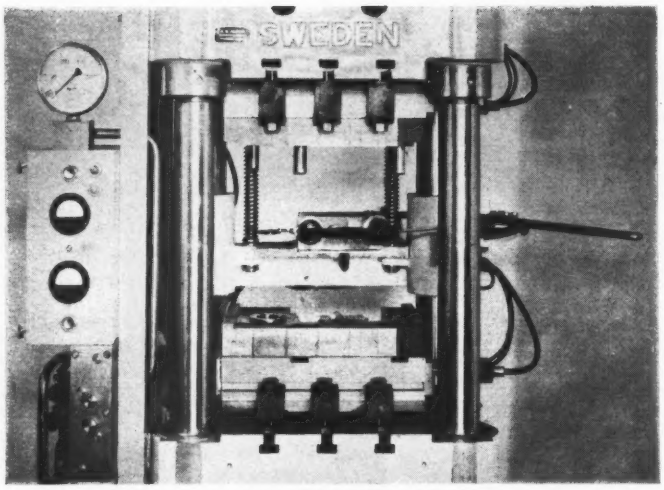


Manufacture of polythene film by the blown extrusion process at the Stockholm plant of Svenska Metallverken.

Some Observations on Pressure Effects During the Injection Moulding of Polystyrene

S. D. Eagleton, Monsanto Chemicals Ltd. Read at the Convention by F. J. Parmenter (Monsanto Chemicals Ltd.).

MUCH of the pressure applied by the plunger of an injection moulding machine is lost before it reaches the mould. Means of reducing the solid zone pressure loss were discussed and an apparatus built to duplicate the compressing action of an injection ram described. Results obtained with this apparatus at different lubricant concentrations were compared with those obtained on an injection moulding machine. The maximum pressure which could be transmitted through the solid zone appeared to be about 70% of the applied pressure, the remaining 30% being converted into heat. While the flow through the injection machine should be free from obstructions it might be necessary when using the dry colouring technique to insert a mixing device in the nozzle. The types of pressure loss caused by such a device were considered and figures were given to illustrate the performance of a preferred design. Figures were given to show the pressure loss caused by a pinpoint gate, and the temperature rise due to this loss was calculated. Due to the rapid decrease in viscosity of polystyrene



(Above) Special assembly for moulding telephone components, at the works of A. B. Alpha, Stockholm.

(Above) Heat-sealing machine for closing plastics food containers, shown at the works of Svenska Metallverken.

with rising temperature, the effect of using a pin-point gate might be regarded as partly self-compensating. The combined effects of pressure and heat conduction on material passing through an injection machine were indicated. The effect of increasing the time for which the injection pressure was applied was to cause an increased tendency to crazing. Annealing was effective, but did not affect the flow patterns seen under polarized light.

A Study of the Problems Involved in High-quality Injection Moulding

E. Gaspar, The Projectile and Engineering Co., Ltd.

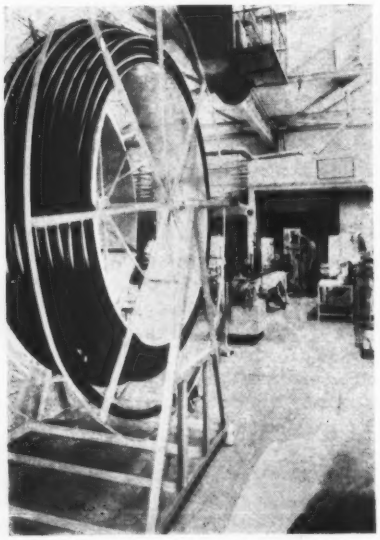
THE extensive series of experiments carried out by Projectile in order to measure the plasticizing efficiency of injection moulding machines and how this could be improved were described. The importance of high plasticizing efficiency, homogeneous plasticization with minimum temperature and pressure variation at the nozzle of the plasticizing chamber was stressed.

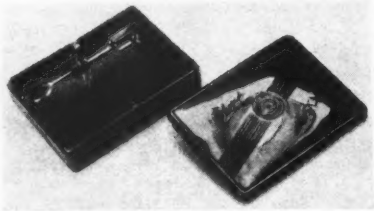
Mould cavity pressures could easily be influenced by temperature and pressure variations at the end of the heating chamber due to the steep variation of viscosity of thermoplastic materials with temperature. In order to obtain consistency of mouldings it was most important to maintain constant cavity pressures. It was shown how small material temperature variations and consequent larger cavity pressure variations could adversely affect the quality of mouldings, such as flow lines, weld lines, sinking, variation of weight, the possibility of distortion during ejection due to residual stresses in the cavity. The question of internal stresses was discussed in some detail and how they can be reduced by controlled "packing" at the end of the injection stroke. Various means to achieve this were described. The results have shown a very considerable reduction in crazing and internal stresses by controlled "packing." With large mouldings these internal stress considerations become more important.

A Brief Survey of Glass-fibre Reinforcements and Their Use with Plastics

A. R. Henning, Fibreglass Ltd.

THE author commenced by stating the advantages of glass fibre for reinforcing purposes, stressing the physical properties of glass filament. Attention was drawn to the normally poor bond between glass and polyester resins and methods of overcoming this were described. The importance of the glass resin ratio and fibre structure were noted.

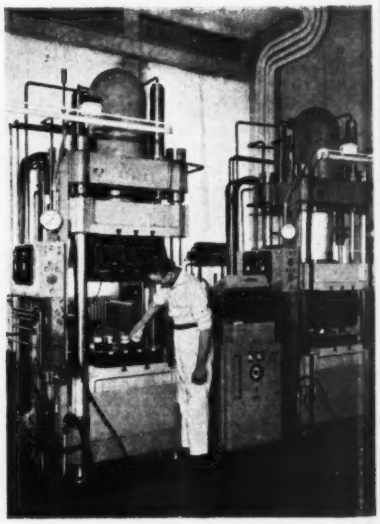




(Above) Box for playing cards, moulded in cellulose acetate-butyrate by the injection process, by Svenska Metallverken.

(Left) Extrusion of polythene pipe by Svenska Metallverken.

(Right) 200-ton down-stroking presses, with pre-heating oven between, at the Stockholm works of A. B. Alpha.



The author went on to describe the production of continuous filament glass fibres and to schedule the unwoven reinforcements as follows: (a) roving—parallel strands of filament used in the manufacture of piping and rods; (b) flock preforms—bonded felts made by chopping rovings and sucking the strands on to perforated metal screens to the shape required for moulding; (c) loose chopped strands—used to reinforce compression moulding and casting mixtures; (d) chopped strand mat—felts of random chopped strands held together by a plastic binder or other means; (e) diamond mat—a web of continuous strands forming an elongated diamond pattern and having unidirectional properties; (f) surfacing mat—a tissue of mono-filaments designed to hold a high proportion of resin on the surface of a moulding and so producing a good finish.

The paper was concluded by a review of the structures at present fabricated from glass fibre and the future possibilities.

Polythene for Film and Paper Coating

M. Jones, Plastics Division, I.C.I. Ltd.

THE use of polythene for the manufacture of film has already become one of the major outlets for this polymer. In 1952 the use in Great Britain and in the United States probably amounted to about 15,000 tons. The paper coating outlet is a more recent development but is extending at a steady rate. The properties of polythene which make it attractive for film and for paper coating are high strength, toughness, a high degree of transparency, and freedom from plasticizers or other modifying agents. A wide range of polymers may be used for the film application, but it has been found that those with a molecular weight (number average) of about 28,000 are particularly suitable, although still better mechanical properties can be obtained by using higher molecular weights. The design of the extruder plays an important part in the production of film, and a machine having a relatively shallow screw of constant pitch decreasing depth is preferred, both for tubular and wide flat film production. The film extrusion process is now being used in place of the old hot melt process for applying thin coatings of polythene on to paper, and coating speeds up to 600 ft./min. have been claimed. Thicknesses varying from 0.5 to 7.0 thousandths of an inch may be obtained, although the more usual range is around 2/1000ths of an inch. By film extrusion methods it is possible to coat paper on one side or on both sides and such materials have already been established widely for use in multi-ply sacks, where one polythene-coated ply can replace two asphalt-coated plies without loss of water vapour impermeability.

Difficulties Encountered during Injection Moulding of Cellulose Acetate and Possible Suggestions for their Elimination

H. Lovell, Courtaulds, Ltd.

THE author dealt chiefly with the operational side of injection moulding, including the importance of complete consultation, between engineer, designer, moulding technician and material manufacturer in the early stages. The use of polaroids for detecting strain patterns in transparent mouldings was discussed; the effects of moulding technique on strain patterns, in order to reach optimum moulding conditions. The physical properties of moulded pieces can be improved by moulding at optimum conditions, and one can quickly become accustomed to the various types of flow patterns which arise. Suggestions for the elimination of various faults when moulding cellulose acetate were mentioned, such as discoloration, "sinks," dull finish, flow lines, burn marks, brittleness or surface laminations and shrinkage after moulding.

Polyester Resins in Reinforced Castings and Low-pressure Mouldings

D. S. Mahon, Bakelite Ltd.

THE first part of the paper dealt with the use of unfilled polyester resins for casting, with particular reference to the potting of biological specimens and electronic components. The techniques for carrying out these processes were described in detail and illustrated with photographs. The use of polyester resins reinforced with glass or asbestos fibres for moulding press tools for the forming of sheet metal were detailed, with illustrations showing the various stages in the production of an actual press tool. The last section of the paper described the use of special types of phenolic resins for laminating at atmospheric pressures. Typical mechanical and electrical properties of these laminates were given. The possible future use of phenolic resins of low shrinkage for the production of press tools, jigs and other components was also discussed.

The Petroleum Industry as a Source of Raw Materials for High Polymers

Dr. M. A. Matthews, The Shell Petroleum Co., Ltd.

THERE has been a very rapid expansion in petroleum chemicals production which began before World War II in the U.S.A., but which in Western Europe took place after the war when most of its refineries were erected. Cheap and abundant raw materials from petroleum are finding a ready outlet in the synthesis of high polymers, the production of which has grown at a high rate since 1940. The principal raw materials forming a basis for high polymer production are: ethylene, acetylene, propylene, butylenes, benzene, naphthalene, C_8 aromatics, formaldehyde and hydrogen cyanide. With the exception of propylene and butylenes, for which the only practicable large-scale source is petroleum, these raw materials were until recently produced from coal. Increasing demand has, however, led to their large-scale production from petroleum, particularly in the U.S.A., where this has outstripped the production from coal. It is estimated that in the U.S.A., 34% of these raw materials will be required for high polymer manufacture by 1960, of which four-fifths will be from petroleum sources. In W. Europe, although the raw materials for high polymer manufacture will come increasingly from petroleum, the proportion so derived by 1960 will be about one-fifth.

The Applications of Unsaturated Polyester Resins with Particular Reference to the Single Mould Process

B. Parkyn, Scott Bader and Co., Ltd.

THE author discussed the essential differences between polyester resins and other plastics materials, the most important being that polyester resins are mainly used as liquids. This fact, more than any other, has lead to the development of many rather unusual moulding processes. The various methods of laminating glass fibre with polyester resins were then enumerated, emphasis being given to the fact that whilst it was often economic to mould large shaped articles, flat sheets could generally be made more cheaply from metal, or other plastics materials. Finally the "single mould process" was discussed in detail. The economics of this method was then discussed, an indication being given of the many factors which should be considered before deciding to make a large article in glass-fibre reinforced polyester resins.

Electro-formed Hard Nickel Alloy Moulds

P. Spiro, London and Scandinavian Metallurgical Co., Ltd.

HARD nickel electroforming is a means of making injection moulds (mainly), cheaper than, but as good as, steel moulds, particularly for small and intricate shapes, especially multi-impression. "Masters" which are almost replicas of the articles to be moulded, are precision machined or formed in Perspex or other materials and covered with a silver layer of negligible thickness, after which a "shell" 5 mm. thick—of tough nickel cobalt alloy of about 45 Rockwell hardness—is electrodeposited on the masters followed by the electrodeposition of a backing of about 250 Vickers hardness. The masters are then removed, the back and sides of the cavities machined to cubic or

(*Continued on page 27*).

Laying a polythene water supply line during a Civil Defence exercise at Hull: (top, left) the light 16-ft. lengths are unloaded from a lorry; (top, right) the metal end sleeves of the pipes are joined by means of a toggle-type clamp; (below) the completed pipe-line along the quay is feeding pumps seen in action in the background.

POLYTHENE WATER PIPES

THE Home Secretary, Sir David Maxwell Fyfe, recently described new fire-fighting appliances which have been designed by engineers of the Home Office Fire Service Department to meet the kind of fire situation that atom bomb attack may cause. Amongst the equipment described was an experimental static water tank which can be rapidly assembled from glass-fibre reinforced plastics sections so light that one man can lift a section that would take several men if it were steel. These tanks are designed to be fed not by the heavy steel pipes that lined the gutters of London in the last war but by flexible plastic piping so light that one man can carry a 16-ft. section on each shoulder and a small squad of men can lay a line at the rate of four miles an hour.

We went to the Home Office Fire Service Department to obtain further details of these applications of plastics in fire fighting equipment, from Mr. F. C. A. Shirling, Engineering Inspector of the Fire Service Inspectorate. Research has been going on for some years to find a suitable material for the manufacture of lightweight pipes to be laid under emergency conditions. Materials which were investigated included aluminium, plywood, glass-reinforced plastics and various extruded thermoplastics materials.

These early tests showed that extruded polythene piping has several advantages over other materials. It is extremely light in weight thus making it easily transportable by road. Specially designed vehicles now being built are capable of taking one-third mile of pipes in one load. The light weight enables it to be carried by hand for considerable distances. Polythene is very tough and no mechanical damage is likely to harm the pipes, e.g. lorries may be driven over the laid pipe-line without causing permanent deformation.

Polythene is of course a very stable material unaffected by storage conditions and can be kept for long periods without any deterioration. Test results showing the mechanical properties of tubes produced over two years ago correspond exactly with the results of tests on the tube when first produced.

Several changes have been made in the design, most important being the fitting of metal end sleeves to facilitate joining lengths of pipe. These aluminium alloy ends, together with the rapid-action toggle clamp used can be seen in several of the illustrations.

The tubing which has a 6½-in. outside diameter and a wall thickness of ⅜ in. is hydraulically tested at 100 lb. of water pressure but considerably higher pressures have been obtained on production samples. This test pressure was selected to

—FOR FIRE SERVICES AND EMERGENCY SUPPLY

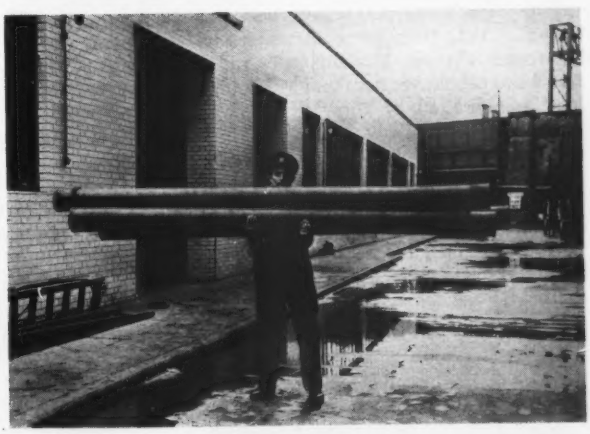
provide the adequate margin of safety compared with working pressures normally employed.

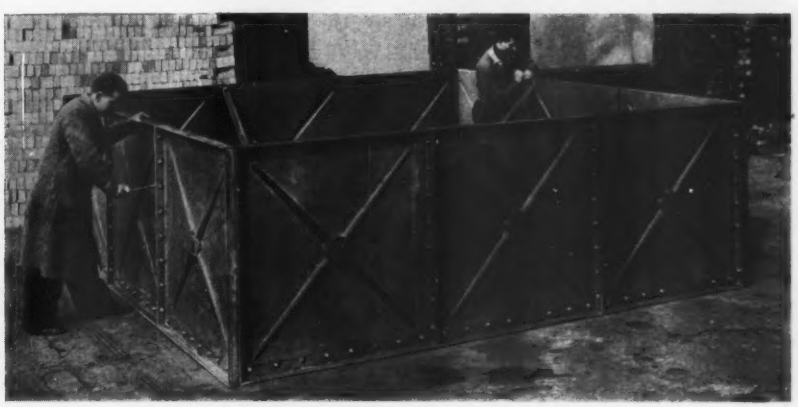
As is usual practice, supplies of pipes are obtained for the Home Office through the Ministry of Works who sub-contract manufacture to various extrusion companies. Specifications cover the materials and the method of manufacture as well as dimensional tolerances and performance. A rigid system of inspection is maintained by the Ministry of Works to ensure that specifications are maintained. The extruded tube is manufactured from I.C.I.'s Alkathene Grade 7 to which 2% of a suitable carbon black and 0.2% of Nonoxal AW anti-oxydant is added. Virgin polymer is specified, with a maximum addition of 10% of clean single-pass rework of the same composition. Considerable quantities of the pipe have already been produced by such companies as Tenaplas Ltd., J. J. Wade and Co., Ltd., The Mange Component Co., Ltd., Chemical Pipe and Vessel Co., Ltd. Some 30 miles is in the course of production at the present moment.

Glass Fibre Reinforced Water Tank

The prototype of the glass reinforced plastics water tank described by Sir David Maxwell Fyfe was seen by visitors to the British Plastics Exhibition in June, 1953. It consists of a number of rectangular panels which are flanged to permit easy assembly by bolting. The mouldings for this tank were produced by Microcell Ltd., for the Ministry of Works.

Both the pipes and the tank have been tried at a number of Civil Defence exercises throughout Great Britain. The illustrations at the top of this page, taken by the London Fire Brigade, illustrate the remarkable flexibility of the polythene pipes, a 90° bend being negotiated in three lengths, i.e. 48 ft.





(Top, left and right) Due to their flexibility polythene pipes can easily be laid over rough ground and diverted round obstacles; (centre, right) lightness of the pipes is demonstrated by one man comfortably holding four lengths. (Photos: London Fire Brigade.) (Bottom, right) Assembling a static water tank from glass fibre reinforced plastics panels. (Photo: Microcell, Ltd.)

LETTERS TO THE EDITOR

Correspondents are reminded that a stamped and addressed envelope should be enclosed in all cases where a personal answer is desired. It is understood that any letter received may be published at the discretion of the Editor.

History of Extrusion (Gutta-percha)

SIR,—I congratulate you on your special "Extrusion of Plastics" number. It covers a very wide field and it is understandable if certain important aspects of the development of extrusion materials have not been given quite the right emphasis, and if certain historical features, which have had a profound effect on extrusion, have been overlooked. For example, the earliest known extruder for making gutta-percha tubing was that invented by Henry Bewley in the 1840s. This machine was later converted by Charles Hancock into a wire-covering machine which was to be the means whereby subterranean and submarine cables were to be insulated with gutta-percha. It was the association of Bewley and Hancock, who signed a patent agreement in 1845, which fixes the birth of the Gutta-Percha Co. (which produced the first telegraph cable across the Channel in 1850) and eventually The Telegraph Construction and Maintenance Co., Ltd.

Telcon has extruded plastics for over 100 years and can, therefore, rightly claim to be the oldest extruding company in the world.

With regard to your reference in the section dealing with wires and cables to polythene as an insulant for radio frequency cables, your readers will doubtless be interested to know that it was Telcon who first saw the possibilities of I.C.I.'s famous plastic as an insulating material, and it was Telcon who first developed polythene for cable application, the first "factory-scale" length of polythene-insulated core being extruded and tested at Telcon Works, Greenwich, in 1938. Incidentally, without Telcon polythene r.f. cables, radar and radio-location would have been impossible in the form used so successfully in the British and American equipment.

In addition to the r.f. and TV cables, Telcon's extruders at Greenwich turn out a wide range of polythene and p.v.c. insulated cables, including power cables, coaxial and multi-quad carrier frequency land-communication cables and, through its associate company Submarine Cables, Ltd., jointly owned by Telcon and Siemens Brothers and Co., Ltd., submarine telecommunication cables with plastic insulation.

P. L. REED,
Public Relations Officer.
The Telegraph Construction and Maintenance Co., Ltd.,
Telcon Works, Greenwich,
London, S.E.10.

Trade Names

SIR,—We should be glad if you could kindly tell us the manufacturers of the following materials:—"Plastisol," "Unichrome" and "Prodorplast." We are most anxious to contact these people and any information which you could supply would be greatly appreciated.

HOOVER (WASHING MACHINES), LTD.
Pentrebach,
Merthyr Tydfil,
Glamorganshire.

[EDITOR'S NOTE: "Plastisol" is the trade name for two resins. One, a vinylite type in viscous liquid form made by the Bakelite Corporation, New York, and two, a vinyl suitable for making gaskets manufactured by Watson-Standard Company, Research Dept., Pittsburgh, Pa. "Unichrome" is manufactured by the United Chromium Incorporated, New York. "Prodorplast" is manufactured by Prodorite, Ltd., Wednesbury, Staffs.]

Luminous Plastics

SIR,—We shall be most obliged if you can assist us with any information concerning where we might obtain a suitable powder, which could be added to injection-moulding powder to cause the final product to be luminized.

At the same time, could you please advise us where we might obtain a rod of pliable polythene 2 in. diameter by 4 in. long.

WELNUT ENGINEERING CO., LTD.
Beach Yard Works,
Holyhead,
Anglesey, N. Wales.

Printing on Plastics

SIR,—We should be much obliged if you could let us have addresses of suppliers of printing machines for the continuous printing of a repeated text on a long length of rubber flexible tubing.

JOHN BULL RUBBER CO., LTD.
Evington Valley Mills,
Leicester.

Lighter Fuel Holder

SIR,—We should like to contact a manufacturer of the type of small plastic capsule which is used for holding lighter fuel.

MORRIS AND CO. (CHESTER), LTD.
Boundary Lane,
Saltney, Chester.

Manufacture of Sponge Bags

SIR,—We shall be obliged if you will let us have all the information possible regarding the making of plastic sponge bags. Can you furnish us with the names of the manufacturers of the cutting-out presses?

We propose manufacturing from the heat-sealing process. Do you consider this an improvement on a stitched article, and is it going to prove a practical proposition for a sponge bag? We would like to have the names of the makers of the heat-sealing machinery and any further information which you think would prove helpful in the initial stages.

VICTOR SPENCER, LTD.
28 Bristol Street,
Birmingham, 5.

Cigarette Cases

SIR,—We shall be pleased to learn the names and addresses of firms whom you consider are in a position to supply us with plastic cases with lift-off lids suitable for holding one American pack of 20 cigarettes.

ROTHMANS, LTD.
13-25 Underwood Street,
London, N.1.

[EDITOR'S NOTE: We believe this refers to samples we have seen from the U.S.A. and France, where the cigarettes pack is rather different from our own. Size is roughly 2½ in. x 3 in. x ¾ in. with a push-on top. Generally made in cellulose acetate and polythene by injection moulding.]

Plastic Card Frames

SIR,—We have received an inquiry for plastic card frames for fixing to drawers, cupboards, etc., and would appreciate it if you would let us have names and addresses of possible suppliers of them.

GRIFFIN AND TATLOCK, LTD.
Kemble Street,
Kingsway,
London, W.C.2.

Acetate Covers

SIR,—A customer wishes us to supply ¼ million small slide covers in cellulose-acetate sheet, .025 in. thick. We would be grateful if you could let us have one or two addresses from whom we may obtain these items, as we ourselves are injection moulders.

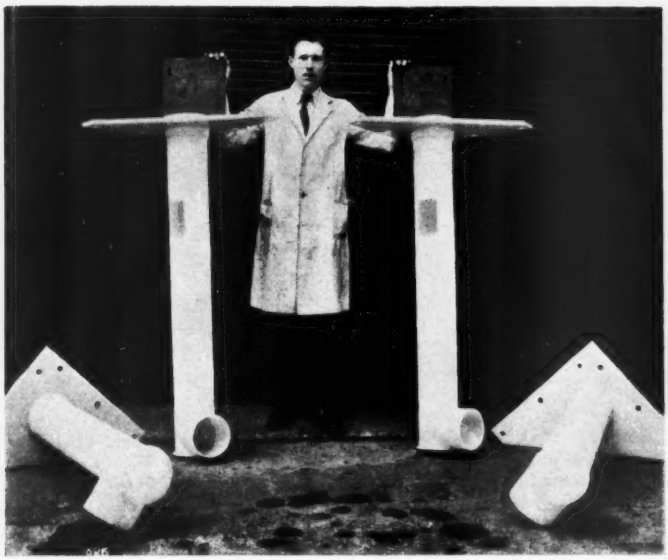
PROGRESSIVE INVENTIONS, LTD.
King Street,
Market Rasen,
Lincolnshire.

Rainwear

SIR,—We are interested in lightweight plastic waterproof manufacturers and should be grateful if you could give us the names of one or two of the largest makers of this commodity.

HILLS (PATENTS), LTD.
Hills House,
Chenies Mews,
London, W.C.1.

New Productions



(Above) Plate stacking cover.

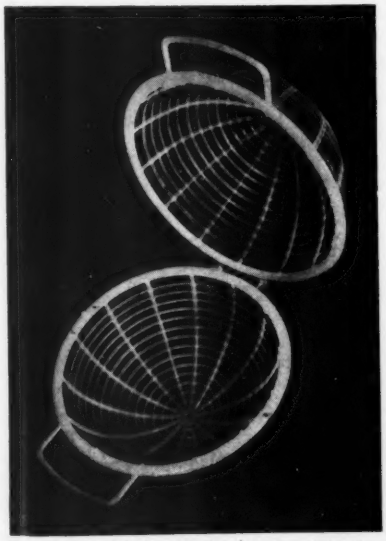
(Left) Polythene fabrications for plating plant.

Plating Plant

A recent fabrication carried out by Rediweld, Ltd., 15-17 Crompton Way, Crawley, Sussex, formed part of a nickel-plating plant. The plastics used were polythene sheet and polythene pipe welded to form components such as the agitators shown. The tubes illustrated were manufactured by the centrifugal casting process.

Salad Washer

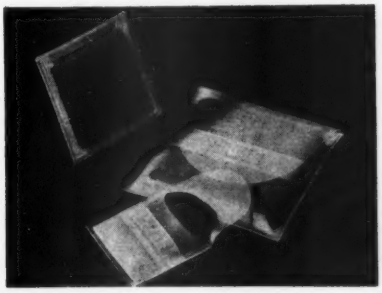
A polythene cage made in France for washing lettuce was described by Dogsboddy on page 332, *Plastics*, October, 1953. A similar household article is now produced



in Great Britain. It has been injection-moulded in polythene by Craxfords (Ramsgate), Ltd., Invicta Works, Ashburnham Road, Ramsgate, Kent. It comprises two mouldings each produced on a 4-oz. injection-moulding machine. The halves are joined by a specially constructed hinge.

Plate Stacking Covers

The clear polystyrene plate covers produced by Mendle Brothers, Ltd., incorporate a flat top with a recessed handle so that a number of covered plates can be stacked one on top of the other thus saving valuable space in pantry or refrigerator. The covers are available in two sizes—7¾ in. diameter by 2⅜ in. high and 9½ in. diameter by 2¾ in. high.



Mixer Top and Lemon Squeezer

A glass jar, intended for the mixing of baby foods, invalid foods, batters, etc., is marketed by Progressive Novelty Industries, Ltd., and has a screw-top injection-moulded in clear polystyrene, by Universal Metal Products, Ltd., Pendleton, Salford, Lancs. The top is so designed that it not only helps in efficient mixing but when removed from the jar it can be inverted and used as a very handy lemon squeezer.

Filter Packages

The range of photographic filters manufactured by Kodak, Ltd., are now being sold in plastic cases welded from natural translucent p.v.c. sheeting. The high-frequency welding operation, which is carried out by the Industrial Applications Division of Cascelloid, Ltd., 9 Conduit Street, London, W.1, includes embossing the trade mark on to the package.

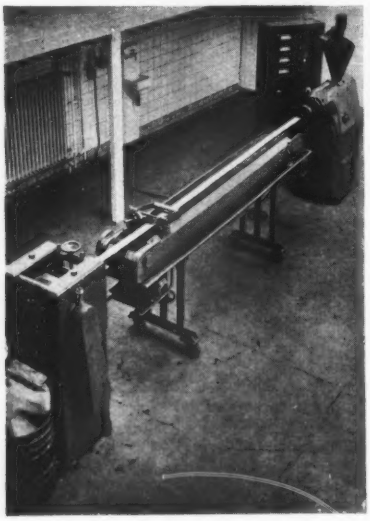
(Left) Kodak filter packages.

(Below) Mixer top and lemon squeezer.

Plastics NEWS

Raw Materials, New Plant, Works Organization, Control Apparatus, Research, Personal and Trade Notes

CUBE GRANULATOR. The illustration below shows a granulator in operation, marketed by Industrial Plastics Ltd., 16-17 Jermyn Street, London, S.W.1, who are world distributors for Coste and Chevaleyre, France. Such machines are now being widely used all over the world in the production of diced thermo-plastic compounds. The small models are used in conjunction with extruder/compounders where the



Granulator geared with 3½" Reifenhauser extruder, dicing p.v.c.

variable-speed gear attached to the cube dicer will accurately control the intake speed of the machine. The larger models are used in conjunction with open rollers, mills and Banburies and have an intake speed of up to 100 ft. per minute on a strip up to 8 to 18 in. wide, depending on the size of the model. Strips up to ¼ in. can be diced.

DOWDING AND DOLL LTD.—Announce that they are now in full occupation of their new offices and showrooms at 346 Kensington High Street, London, W.14. (Telephone: Western 8077). The spacious showrooms, which are only a few hundred yards from Olympia, will house a good selection of their specialized range, and visitors will be welcome, to inspect these machines in operation.

WITCO CHEMICAL CO., LTD., announce that they have acquired a modern manufacturing plant at Union Lane, Droitwich Spa, Worcestershire. At this new factory the company will manufacture latex compounds and auxiliary chemicals, adhesives, wax and rosin sizes and certain types of lubricants and emulsions.

HORNFLOWA, LTD.—Mr. R. G. Wallace, C.A., secretary and accountant of the company, has been appointed to the Board.

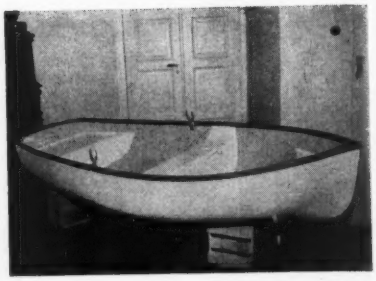
BRITISH VISQUEEN, LTD., the joint company to manufacture polythene film formed by I.C.I., Ltd., and the Visking Corporation of Chicago, Illinois, will commence trading during February. Its products will include "Visqueen C," a special film which overcomes the problem of ink adhesion on polythene film. British Visqueen's new plant and offices being built at Stevenage will not be completed until July or August. In the meantime, the company's headquarters will be at 94 Tewin Road, Welwyn Garden City, and plant is being installed in temporary premises at Hillhouse in Lancashire.

MR. DONAL SULLIVAN, late of De La Rue and Co., Ltd., and now Commercial Manager of Southern Airfreight Products Ltd., has in addition now joined Erinoid Ltd., as adviser to the technical service of their extrusion department. He takes with him the experience of many years in the plastics extrusion industry. He will retain his active interests in the British Plastics Federation as the representative of Erinoid Ltd.

MR. J. R. HARDING, B.Sc.(Eng.), M.I.E.E., has been appointed assistant general manager of Pirelli-General Cable Works, Ltd. He joined Pirelli-General Cable Works, Ltd., in 1925 and has been successively a district engineer, manager of overhead lines department, deputy sales manager for rubber cable and joint sales manager for paper cable with Mr. R. J. Willoughby.

NEW APPOINTMENTS AT I.C.I. PLASTICS DIVISION.—Mr. J. Hargreaves has been appointed sales manager of the Midland Region Plastics Department. He joined I.C.I. in August, 1929, and was, until taking up his new post, manager of Home Sales Control Department. Dr. F. T. Hamblin has taken Mr. Hargreaves' place, having until recently been manager of Techno-Commercial Department at Welwyn. Dr. W. E. Batten has been appointed manager of the Techno-Commercial Department.

P. B. COW AND CO., LTD., announce an interim dividend of 7½%.



Polyester resin, in conjunction with glass fibre, was used in the construction of this dinghy by the Norwegian Plastics Federation.

O. AND M. KLEEMANN, LTD., have announced a final dividend of 25%, making a total of 50% for the year ending August 31, 1953.

DAVID BRIDGE AND CO., LTD., engineers and iron founders to the plastics and other industries, has become a public company.

THE RECONSTITUTION OF SCRAP. NEW COMPANY FORMED.—The reconstitution of thermo plastics scrap and the problems involved in its reprocessing have aroused much interest throughout the industry. Numerous articles and exchanges of correspondence recently appearing in the technical Press stress the vital importance from an economic standpoint of reclaiming to the limit all available and useable scrap material in the plastics industry as in other fields. Of even more importance is the application of scientific methods and know-how in order to obtain the maximum value and most satisfactory results in the use of the reconstituted material. The formation of a new company making full use of the knowledge and experience gained in dealing with such problems is of topical interest. Under the title "R.H.C. Reclamations, Ltd.," a company has been formed by R. H. Cole and Co., Ltd., which couples their own activities with those of Plasticators, Ltd. Management and personnel will comprise the existing members of both companies who have a wide experience of the requirements of the plastics moulding industry, the board of directors being that of the two combined companies. The company's processes will be carried out at the existing plants at 85 Southdown Road, Harpenden, Herts, under the direction of Mr. G. G. Small who has been appointed technical director. Plans for extensive developments have been laid.

(Right) Visitors to Stockholm photographed at the reception given by the Swedish Plastics Federation, from left to right: Mr. H. Lovell, Mr. P. A. Sauter, Mr. C. W. Welch, Mr. D. de Neergaard, Mr. F. G. Brabner and Mr. J. Butler.

(Left) Twin-head design of Formvac machine permits continuous manufacture. Operator on left is shown removing two halves of a small suitcase. Full moulding area of machine is 24 by 36 in.

"FORMVAC" VACUUM FORMING MACHINE.—Dowding and Doll, Ltd., 346 Kensington High Street, London, W.14, have been appointed sole United Kingdom agents for the Swiss-built "Formvac" automatic vacuum deep drawing and forming machine for use with thermoplastic sheets.

ERINOID LTD.—In the table of extrusion compounds published on pages 424 and 425 of the December issue of *Plastics* figures given for the H.S. grade of polystyrene of Erinoid Ltd. were in fact those for cellulose acetate. The correct figures for the H.S. grade of polystyrene are as follows:—specific gravity, 1.05-1.07; softening point, 98-93°C.; maximum service temperature, 80°C.; minimum service temperature, −40°C.; water absorption (M.G.), 0.03-0.06; extrusion temperature, 160-220°C.; decomposition temperature, over 300°C.; tensile strength, 7,000-8,000 P.S.I.; abrasion resistance, fair; Youngs modulus, $5\text{-}6 \times 10^5$; elongation at break, 1.5-2.0%; volume resistivity, 10^{13} ohms/cm^3; dielectric strength, above 400 volts per mil; power factor, 0.0001-0.0005% at 10^6 cycles; resistance to acids, good; resistance to alkalis, excellent; resistance to benzene, toluene, petrol, white spirit and chlorinated compounds, poor.

NEW SECRETARY FOR PLASTICS INSTITUTE.—Mr. N. E. Griggs, B.Sc. (Econ), A.C.I.S., has been appointed as Secretary to the Council of the Plastics Institute and commenced his duties in December. Mrs. B. Feldman has been appointed Assistant Secretary to the Council.

Mr. E. K. Cole (right) welcomes back Mr. N. C. Robertson.

E. K. COLE, LTD.—Cordial greetings were extended to Mr. N. C. Robertson, M.B.E., when he resumed his duties as deputy managing director, after service with the Ministry of Supply.

MR. C. L. MORE, B.Sc. (Bombay), has left this country after a stay of some three years returning to Bombay to begin work as a consultant in plastics and rubber. He has done much useful work with Joseph Lucas, Ltd., and Compoflex, Ltd., spent two years in the laboratories of Dr. V. E. Yarsley and received the Diploma of the Plastics Institute. We wish him a happy and successful future.

C. G. G. HAYMAN, director, and chairman of management committee, Distillers Company, Ltd., was created a Knight Bachelor in the New Year Honours List.

BRITISH GEON LIMITED.—Dr. J. J. P. Staudinger has been appointed to the Board of British Geon Limited. He is already a director of British Resin Products Limited.

MR. G. C. GRAVER, previously in charge of publicity and information work in British Geon Limited has been appointed manager of the publicity and information department covering both British Geon and British Resin Products. Mr. Graver is already well known in the industry for his work in the thermoplastic field in connection with British Plastics Federation and British Standards Institution committees.

BRITISH RESIN PRODUCTS, LTD.—Mr. E. J. Westnedge has been appointed General Sales Manager of the Company and Mr. J. D. Winston has succeeded him as Sales Manager, Moulding Powders. Mr. D. N. Davies has been appointed development manager (Moulding Materials) and Mr. P. Brown, Consumer Service Manager (Moulding Powders). At the B.R.P. factory at Barry Mr. T. E. Laing now occupies the position of general manager, Mr. D. A. Bennett having been appointed works manager.

W. ADAM.—We regret to announce the death of Mr. W. Adam, who joined F.A. Hughes, Ltd., in the early days of the plastics industry and for so long continued to work in the British Geon organization. He died at the age of 80.

MONSANTO CHEMICALS, LTD.—Mr. D. R. Mackie has been appointed commercial director of the company, Mr. E. L. Pixton, Mr. D. C. M. Salt and Mr. J. S. Hunter, sales controllers, and Mr. W. M. Thompson director of purchases.

MONSANTO PLASTICS, LTD.—Monsanto Chemicals, Ltd., announces the formation of a new and wholly owned subsidiary company, Monsanto Plastics, Ltd.,

registered on December 31, 1953, with an initial capital of £100. Directors of the new company are J. W. Barrett, D. R. Mackie, N. F. Patterson, E. L. Pixton, P. A. Singleton and J. W. Urban. Mr. Gilbert Dodd is named as general manager.

DR. G. A. ROHAN, former technical director of Alfa Plastics, Ltd., and now a consultant, has changed his telephone number to Elmbridge 9880.

BAKELITE LTD., announce the following executive staff changes to be effective from January 1, 1954, necessitated by the continued expansion of the company:—Mr. A. Lloyd previously joint manager thermosetting division and works manager at Tyseley, to be general works manager; Mr. G. J. Taylor previously joint manager thermosetting division and thermosetting division sales manager to be manager of the thermosetting division; Mr. P. Smith, previously sales manager laminated materials to be sales manager thermosetting division;

Mr. A. Lloyd.

Mr. C. E. Tofts previously assistant to Mr. P. Smith to be sales manager laminated materials; Mr. R. Hulse previously manager of moulding material production at Tyseley to be works manager, Tyseley; Mr. A. Tonks previously works technical department to be manager moulding material production at Tyseley. The Thermosetting Division of Bakelite Ltd., is the major division of the company and handles the production and sales of all thermosetting products, i.e., synthetic resins, moulding materials and laminates.

MR. G. HUGHES AWARDED M.B.E. IN NEW YEAR HONOURS LIST.—He has just completed 25 years service and is at present senior foreman in the laminated production department, Bakelite, Ltd. He was one of the earliest workers in this country on the manufacture of laminated plastics.

THE PLASTICS INSTITUTE WESTERN SECTION.—134 people attended the Western Section's Third Annual Dinner Dance which was held at the Queen's Hotel, Cheltenham on December 4, 1953. Following an excellent dinner, the Loyal Toast was proposed by Mr. J. L. Daniels B.Sc., M.I.Mech.E., F.P.I. (Chairman, Western Section). The toast "The Plastics Institute" was proposed by Mr. N. D. Wakeham, M.A. (Former Chairman, Western Section) and Dr. V. E. Yarsley (President) D.Sc., M.Sc., F.R.I.C., M.I.Chem.E., F.P.I., replied. Mr. A. A. Heath M.A. (Founder Chairman, Western Section) proposed the toast "Our Guests" to which Mr. H. F. Wilson, B.Sc., A.R.I.C., A.I.R.I., Companion I.E.E., F.P.I. (Chairman of Council) replied. Among others present were Mr. P. C. Chaumeton B.Sc., F.R.I.C., M.I.Chem. E., F.P.I., (Vice-President), Mr. J. R. K. Russell B.Sc. (Chairman, South Wales and Monmouthshire Section), Mr. R. McDowall B.Sc. (Chairman, Southern Section), Mr. C. W. Oakhill (Hon. Secretary, London and District Section) and Mr. P. Brown (Vice-Chairman, London and District Section). Mr. P. Young (Committee Member, Western Section) acted as M.C. at the dance which followed. Prizes were kindly presented by Halex Ltd. and Insulators Ltd. Each lady present received a white lace-edged handkerchief.

PLASTICS INSTITUTE — MIDLAND SECTION.—A joint meeting of the Plastics Institute, Midland Section, and Birmingham College of Technology was held under the chairmanship of Dr. F. L. Hudson, at which Dr. V. E. Yarsley presented Institute Diplomas and City and Guild Certificates to successful students of the College. Mr. H. F. Wilson, Chairman of Council, and Mr. Griggs, Secretary of the Institute, were also present. In his opening remarks, Dr. Yarsley made a general survey of the development of the Plastics Industry and pointed out the opportunities arising from its continued expansion. Replying for the College, Mr. J. Wilson, the Principal, emphasized the need for close relationship between education and industry, and described the work of the College in furthering this.

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS AND POLYMER GROUP.—A full programme has now been arranged for the symposium on "Chemistry and Physics of Synthetic Fibres," to be held at the Institution of Electrical Engineers, Savoy Place, London, W.C.2, from March 24 to 26. All the major fibre-producing companies and research laboratories in the United Kingdom are contributing.

GLASS REINFORCED PLASTICS LAMINATES.—James Mitchell and Son (Greenock), Ltd., Greenock, the large Scottish metal pipe manufacturers, have announced the introduction of Lamtic Engineering Plastics. A complete range of pipes and fittings is supplied—the pipes up to 15 ft. in length. Other standard products include sectional tanks for erection to suit capacity and site requirements. Vessels, hoods, ducts, etc., can be produced to customer' requirements. Lamtic materials are said to cover the useful range of glass reinforced plastics laminates.

HALEX LIMITED.—As part of an internal reorganization, Halex Ltd., which now acts as the selling company of the Halex Division of The British Xylonite Co., Ltd., ceased to operate on December 31, 1953, and from January 1, 1954, all selling activities will be carried out by the Division itself trading as "Halex—A Division of the British Xylonite Co., Ltd." The Halex Division will undertake responsibility for all outstanding commitments and liabilities of Halex, Ltd., and existing sales contracts and orders on hand will be executed in the normal way.

ERINOID LIMITED have asked us to state that the Waterstop Extrusions referred to in the December issue of *Plastics* were introduced by Expandite Limited, Chase Road, London, N.W.10, the manufacturing only being carried out by Erinoid Limited.

LECTURES IN GLASS FIBRE LAMINATES.—Commencing on Thursday, January 21, a programme of special lectures on glass fibre reinforced polyester resin materials will be held at the Borough Polytechnic, Borough Road, London, S.E.1. The fee for the course is one guinea and application should be made for forms of admittance to the Secretary of the Polytechnic. The programme of lectures is as follows, commencing in each case at 7 p.m.: January 21: Types of resins—preparation and properties. January 28: Types of glass fibres, fillers and preforms. February 4: Scope and general trend in glass fibre reinforced structure. February 11: Commercial production of glass fibre mouldings. February 18: Polyester moulding materials not necessarily glass fibre filled.

POLYSTYRENE REFLECTOR LENSES.—In the description of rear light reflector lenses made by Fairylites, Ltd., Manor Hall Road, Southwick, Sussex, which appeared in the New Productions pages *Plastics*, November 1953, it was stated that these lenses were made from high impact polystyrene manufactured by Monsanto Chemicals, Ltd. We understand from Fairylites, Ltd., that the material employed was in fact Lustrex L, the general purpose grade polystyrene made by Monsanto. Although this grade is available in transparent and opaque shades, high impact polystyrene is in fact only available in opaque colours.

Book Review

Welfare and safety in the factory are features of industrial life which have assumed quite a different aspect over the last 50 years. Companies which are large enough to afford them have effective welfare organizations, and all organizations, large and small, are anxious to observe the safety regulations prescribed by law. In addition, the wise employer, realizing that safety precautions will reduce absenteeism due to sickness and accidents, will do all he can to guard his employees against the varying hazards of their work.

However, the range of industrial hazards is enormous, embracing as it does the extraction of dangerous fumes, the guarding of power presses, and the avoidance of skin diseases, to name only a few. "Factory Health, Safety and Welfare Encyclopædia," by C. Conway-Plumbe, is therefore a welcome and valuable guide to all concerned with these subjects. Mr. Plumbe has experience both in factory management and as a factory inspector, and has therefore been able to prepare this book with authority. The information is assembled alphabetically, with cross references to guide the reader.

328 pages, published by The National Trade Press, price 30s. net.

MEETINGS

January

15th.—Plastics Institute, London Section, Annual Dance. Criterion Restaurant, Piccadilly, London, W.1.

15th.—"Productivity and the American Moulder," A. L. Sparshott, B.Sc., Witton Moulded Insulation Works (General Electric Co. Ltd.). Plastics Institute, Midlands Section, Birmingham.

18th.—"Epoxy Resins," E. S. Narracott, Ph.D., D.I.C., A.R.I.C. Plastics Institute, London Section, Waldorf Hotel, Aldwych, London, W.C.2. 6.30 p.m.

19th.—"Some Chemical and Technological Aspects of Silicone Resins," P. Griffin, Midland Silicones, Ltd. Society of Chemical Industry, Plastics and Polymer Group, Burlington House, Piccadilly, London, W.1. The Plastics Institute is invited. 6.30 p.m.

20th.—"Some Problems Involved in the Colouring of Plastics," C. H. Hall, Imperial Chemical Industries Ltd. Plastics Institute, Scottish Section, Institution of Engineers and Shipbuilders in Scotland. 7.30 p.m.

20th.—"Injection Moulding Machines and Pre-plasticizing Attachments," K. W. Norman, Grad. I.E.E., Francis Shaw and Co. Ltd. Plastics Institute, Western Section, T. H. and J. Daniels Ltd., Stroud. 6.30 p.m.

21st.—"Electrical Testing of Plastic Materials," W. Reddish, Imperial Chemical Industries Ltd. Plastics Institute, North-eastern Section, The Neville Hall, Newcastle upon Tyne. 7.0 p.m.

22nd.—"Injection Moulding of Vinyl and Nylon Type Polymers," G. Campbell, Imperial Chemical Industries Ltd. Plastics Institute, North-western Section, Engineers' Club, Albert Square, Manchester.

29th.—Annual Dinner Dance, Plastics Institute. North-western Section, The Grand Hotel, Manchester.

February

1st.—"Production and Development of Chemicals for the Rubber Industry," Dr. J. W. Barrett. Society of Chemical Industry, London Section, Burlington House, Piccadilly, London, W.1. 6.30 p.m.

4th.—"Some Aspects of the Chemistry and Utilization of Lignin," Dr. R. H. Farmer. Plastics Institute, Southern Section, Polygon Hotel, Southampton. 7.30 p.m.

10th.—Prof. F. S. Dainton, M.A., B.Sc., Ph.D. Plastics Institute, Yorkshire Section. Joint Meeting with Organic Chemistry Department, Leeds University. 7.0 p.m.

10th.—"Questions and Answers," informal meeting. Plastics Institute, South Wales and Monmouthshire Section. Cardiff Technical College. 7.0 p.m.

TALKING SHOP . . .

Plastics Do a Heavy Job. During the course of the construction of the new power station at Uskmouth, plastics were called in to solve a difficult problem. For pile-driving purposes a dolly is normally employed, made from English elm, which acts as a cushion and is fitted into a steel helmet covering the head of each pile. Dollies of this kind were used at first at Uskmouth but with disastrous results. The timber was pummelled into something resembling a sponge. Sawdust pads, coconut matting and specially quilted asbestos cushions were tried in an attempt to overcome the problem which was ultimately solved by the use of resin-bonded timber laminated dollies of some 92-ply 4 in. in depth and capable of withstanding 43,000 lb. per sq. in. pressure. We understand that these dollies were fabricated from Bakelite materials.

* * *

Acid-resistant Cement. The Scientific Correspondent of the *Financial Times* recently reported a new cement having a vinyl base and said to be completely resistant to hydrochloric and phosphoric acid. Called Vitroplast and manufactured by The Atlas Mineral Products Co., Mertztown, Pennsylvania, United States, the cement can be used for joining ceramic tiles or bricks when they are used under corrosive conditions. No acid or alkali setting agents are required.

* * *

German Car Bodies. The Bonn correspondent of the *Financial Times* has been investigating German interest in plastics for motorcar bodies. He believes that the first car in Germany to be equipped with a plastic body may come from the Eisenach car plant, in the Soviet Zone. The development of such a body is already being boasted in the East German Press. The material used appears to be a high-pressure laminate similar to that used by the Auto-Union experimentally in 1938. During the past war bomb-ways and battery cases were made from the material. The high-pressure process, however, proved too costly for motorcar bodies. Although Britain and the U.S. evidently have a lead in the field of low-pressure glass fibre polyester laminates, German heads of laboratory claim that they are catching up. They estimate that it will be five years before the German motor industry starts turning out plastic car bodies at a commercial scale.

At a recent meeting of steel executives in Dusseldorf, Professor Schenck created quite a stir when he quipped: "I have reason to assume that our friends in the chemical industries, who are demanding such huge sums for investment purposes, do not aim only at producing more aspirin for our headaches."

In Britain, the motoring correspondent of the *Birmingham Evening Despatch* states that the plastics-bodied Singer sports car, which was introduced at last October's Motor Show in London, is now nearing the stage of production in comparatively large numbers.

Only 343 Shopping Days to Christmas. A recent issue of the *Birmingham Evening Despatch* records a drip-mat of the cardboard variety to be found in most pubs, with a device running through the middle fabricated from plastics and resembling in appearance a bootlace. By running one's thumbnail down the plastic lace the contraption utters the words "Happy Christmas."

* * *

Furniture Productivity. The furniture manufacturing industry was one of the industries which sent a team to the United States under the auspices of the Anglo-American Council of Productivity. Their report was published in April, 1952. A review published by the British Productivity Council, 21 Tothill Street, London, S.W.1, describes progress which has now been made in the industry. This document is by no means as well planned or presented as the actual Productivity Reports, but it does contain interesting information about the growing awareness of productive efficiency in British industry. Curiously enough, no mention is made anywhere in this review of the way in which synthetic resins adhesives and finishes have helped to improve the quality and speed of production of furniture produced in Great Britain. An important lapse in view of the contribution of synthetics to this industry.

* * *

Wall Panels. Several newcomers to the field of plastic wall panelling manufacturers were reported on this page last month. *The Hardware Trade Journal* now announces that North British Plastics, Ltd., of Blaydon-on-Tyne, Co. Durham, have re-introduced their pre-war product Lacotile. This glazed hardboard is available in two qualities: Panalac Lacotile at a consumer price of 2s. 6d. a sq. ft. and Challenge Lacotile at 1s. 10d. a sq. ft. The panels consist of a fibrous board faced with a hard, washable decorative finish and marked out in a 4-in. by 4-in tiled pattern.

* * *

Behind the Picture. Many of the Flemish paintings now on show at the Royal Academy in London have been, according to the *Evening Standard*, "chemically protected against changes in temperature and humidity. The backs of the panel paintings —roughly half of those on exhibition have been treated with a plastic substance." The precaution was taken because the Royal Academy galleries have no ventilating system. The suggestion of treating the panels in this way came from Professor H. J. Plenderleith, of the British Museum.

* * *

45-ft. Reinforced Plastic Motor Yacht. Our associate journal *Motor Boat and Yachting* described in December, 1953, plans for the construction of a 45-ft. motor yacht built entirely of reinforced plastics. The naval architect responsible for the design is Peter Thornycroft, A.M.I.N.A., of Bembridge, Isle of Wight. Halmatic, Ltd., of London, are the sponsors, and the hull will be moulded in the concern's Portsmouth factory. The mould is being made by Messrs. H. Attrill and Sons, of Bembridge, Isle of Wight, who will also fit out the cruiser when the shell has been cast. The cruiser is based on a 48-ft. motor passenger launch which Mr. Thornycroft designed last year for Attrill's, and has been in service for a season.

The same issue of *Motor Boat and Yachting* reports on the construction of small plastic boats in the U.S.A. The U.S. navy has 65 26-ft. plastic motor whale boats on order, each of which is to cost about £2,250. It is believed that there are now 20 manufacturers of plastic boats and the output last year was between 2,000 and 3,000 dinghies and cruisers. A 42-ft. ketch was recently completed.

* * *

3,400-gallon Plastic Tank. The *Irish News* for December 15 reports the construction in America by the American Cynamid Co. of a lightweight plastic trailer tank for the road transport of liquid chemicals. The announcement states that since the glass-reinforced plastic tank weighs 33% less than a steel tank of the same volume payloads can be increased without violating highway weight limitations set by State Governments to protect road surfaces. The tank is 22 ft. in length, weighs just over 7,000 lb. and holds 3,400 gal. This appears to be a logical development of the large static water tank fabricated from polyester glass fibre reinforced plastics by Microcell, Ltd., and exhibited at the Plastics Exhibition in June.

* * *

Modernized Windmill. A reader writing to the magazine *Illustrated* describes one of the few windmills in Britain with the unusual feature of having five sails. This windmill in Burgh-le-Marsh, in Lincolnshire, has the added distinction of being modernized by the fitting of silent plastic gearing.

* * *

Safeguarding Quality in the Home. It has long been the cry that the average consumer cannot be expected to know or even to learn the technical facts necessary to enable him (or more probably, her) to judge quality in plastics products. Informative labelling programmes such as are used extensively by U.S. manufacturers and by a few in Britain can help to educate enthusiastic laymen, but more guidance is required by most shoppers. The Good Housekeeping Institute's award of a seal guaranteeing the good value and efficiency of products removes this worry from purchasers. The growing importance of this seal is persuading more and more manufacturers to submit their new products to be tested by the Institute. The tests are purely practical in nature and are concerned with behaviour in operation rather than with properties determined in the laboratory. If the scheme grows, as it is likely to do, the Good Housekeeping Institute may find it useful to collaborate further with technologists in industry to find ways of maintaining and improving the quality of household products. If all manufacturers can be influenced to submit consumer products to some organization of this kind, industry will have made a large step forward.

PLASTIKON.

NYLON EXTRUSIONS

Some Notes on Their Properties, Test Procedure and Results

By E. E. HALLS

Following the publication of the special extrusion number of "Plastics" in December, Mr. Halls has prepared the following short notes on experience gained in the use of nylon as an extrusion compound. Various test results are included.

NYLON is a relatively new raw material in this country; particularly is this true for the "engineering" industries. It is a thermoplastic which can offer the usually recognized advantages of this type of plastic, for example, ease of manipulation through fabrication processes such as extrusion and injection moulding. This mode of regarding a new material is, however, insufficient and misleading. New materials are not required by industry just for the sake of change. Those which can replace existing ones with increase in productivity or to marked economic advantage, are always welcome. The newer plastics are generally a little more intricate to use and more costly from the material price angle; this is rarely to their disadvantage. What is required are materials that will serve in applications in which known ones are unsatisfactory or do not function with complete success. When the price per pound is relatively high, and adjustments have to be made to existing techniques of fabrication, a period of development by putting the material to sensible applications, gives time for technologists to "get the measure" of the new material in the fullest sense, not only with respect to properties from a laboratory angle and to processing procedures, but also with regard to serviceability from actual field trials. At the same time, the material producer has an opportunity to assess the potentialities of the new material, to produce desirable modifications, and to improve production conditions which will ultimately have a favourable impression upon price.

An appraisal of properties in some detail is essential with these new plastics and this is probably more necessary with nylon than with many others. It is essential to appreciate the special differences, for example in physical and mechanical qualities, as well as to obtain a measure of shortcomings, which, of course, are inevitable in some measure with all materials

Strictly, nylon "is" a group of materials, which are polyamides, rather than a single material, although at present for individual applications only a single type may be commercially available. It is different from the well-established thermoplastics such as cellulose acetate and acetate-butyrate, and polyvinyl chloride, in exhibiting a high softening or melting point. This is of the order of 210-220° C., but the melting range is very narrow, being about 10° C. from solid to free-flowing liquid. This characteristic influences manipulation processes and the possible applications of the finished product. It makes injection or extrusion comparatively more difficult because a greater heat has to be supplied to the chamber or reservoir of material to raise it to the extruding temperature, more control with temperature indicators and recorders is required in the transfer of the material through the orifice to mould or extrusion system, and with the cooling system. In extrusion, this adds to the care necessary in carrying the extrusion away from the extruder without inducing strain which may at subsequent stages give troubles from distortion or dimensional instability.

The high softening point signifies that, from the point of view of retaining shape, nylon components can be exposed to higher temperatures in service than can those made from the cellulose plastics and p.v.c. Results from specific applications and service must be awaited before authoritative directives can be given. Slight oxidation gradually occurs at elevated temperatures so that discoloration very slowly occurs at, for example, 150° C. with extended exposure. Tensile strength falls, and impact strength rises, with increasing temperature. In applications under stress, for example, compression, a service temperature in the region of 75° C. may be a limiting factor.

High impact strength is another characteristic of the nylon materials, so that nylon components are almost unbreakable. Again, it is easily machineable, so that components can be fashioned from extrusions. The lower thermal conductivity and smaller modulus of elasticity, when compared with metals must be observed in machining. Tools must be keen, with correct clearances and angles. A coolant, preferably water, is often advisable.

A feature that may have adverse repercussions is the susceptibility of nylon to water or humidity, so that it "breathes" with changes in hygrometric conditions. Corresponding changes in dimensions may occur and must be allowed for. The increase in dimensions corresponding to humidity exposure alternating from maximum dry to maximum wet may be up to 15 mils per inch. This of course is a property to which users are accustomed with other plastics.

What are the principal fields for application of nylon extrusions? Mechanically the material is of high order; e.g.

Impact strength, Izod, 1.0 ft./lb. per inch of notch at normal temperatures, rising to 1.5 at 50° C. and about 13 at 100° C.

Tensile strength, 10,000 lb./sq. in. dropping to 6,000 lb. at 150° C.

Cross breaking strength, about 14,000 lb./sq. in.

Applications where a robust character is required, and the components are subjected to severe mechanical stress are warranted by these mechanical qualities. Gears and bearings are examples of such.

Chemically, nylon has shown good resistance to alkaline environments, but rather less promising service under strong acid conditions. It is non-toxic, and satisfactory for medical and surgical use.

Electrically, breakdown strength is of good order under dry conditions, although power factor and permittivity (0.02 and 3.6 respectively at 1 megacycle) give the material no claims for high frequency use as a low-loss material. Volume resistivity is not of high order, although insulation resistance under damp conditions has in some applications proved very good. Thus the material is not yet established electrically under damp conditions when high electric strength is a criterion of choice, but it has where insulation resistance has been of greater moment.

In the electrical industry, very little nylon has been used to date, and, where performance has been established, injection mouldings are utilized wherever apt and quantities justify the tooling costs. However, it is being considered in a number of applications and small-scale trials as well as established usage uses extruded nylon, usually in the form of circular section rod. The latter is available over the diameter range of about ½ in. to 6 in. Small "rods" are also procurable, e.g., $\frac{1}{16}$ in. diameter. These are used for cutting into short lengths to be employed as rivets. The latter are assembled and the ends

formed over by pressing with a hot tool. They give satisfaction for fixing small insulators together, as well as for assembling small components on to chassis, panels, etc.

The particular use of the larger extrusions is for parting-off and machining gear forms, and for producing the rotors and starters of rotary switches. The combination of nylon to nylon is particularly attractive in these applications, as well as the possibility of operating without lubrication. In testing assemblies under the standard tropical conditions tests results have shown that clearances must allow for expansion due to humidifying. If design cannot take care of this, serviceability is restricted to dry conditions.

The problem of dimensional change may not prove so complicated as for injection moulding. In the latter, the mould shrinkage is of the order of 14 to 20 mils/inch, but a post-moulding shrinkage occurs during the subsequent three to four weeks. This is dependent upon conditions of moulding and is small, being only of the order of 2 mils per inch. With extrusions, the user is concerned with the material as he uses it, which may be quite a time after extrusion, and any dimensional adjustment in length due to the extruding technique will probably have occurred naturally.

Table 1 shows the changes which occurred when a small-diameter extrusion was exposed for a short period of time to tropical conditions. Under dry heat, about 1% loss in weight occurs, and shrinkage in both directions; less than 1% in the axis of extrusion, but nearly 2% in the cross direction. Upon rehumidifying at elevated temperature, the loss in weight is not only recovered but a further 1% of water is taken up. On dimensions, the hot, wet conditions result in the length increasing a little beyond the original, but the diameter only comes back to the initial value.

Table I

Measured Changes in $\frac{1}{16}$" diameter Nylon Extrusion under Tropical Test Cycles

CYCLE No.	1	2	3	4	5
Conditions	Dry Heat for 16 hours at 70°C.	Wet Heat, 100% humidity for 16 hours cooling off for 8 hours	As cycle 2	As cycle 2	Cycle 2 extended for total of 10 wet cycles
Total per cent. Change for initial condition in :—					
(a) Weight ..	Loss 0.87	Gain 0.90	Gain 1.05 Increase 0.33	Gain 1.15 Increase 0.33	Gain 1.20 Increase 0.40
(b) Length ..	Loss 0.65	None	None	None	None
(c) Diameter ..	Loss 1.75	None			

Table 2 shows the effect of complete water immersion on a larger extrusion. The weight increase is of the same order as given in the previous table for wet conditions, and the dimensional increases, which are very small, are of similar order.

Table II

Measured Changes in $\frac{11}{16}$" diameter Nylon Extrusion under Water Immersion Conditions, 24 hours at 25°C.

Change in Length Per Cent. ..	.. 0.17% Increase
Change in Diameter Per Cent.	.. 0.15% Increase
Change in Weight	.. 1.05% Increase

As far as can be judged from limited tests, water loss or absorption and dimensional changes during fluctuations in heat and humidity are not great, and are such that should give designers no difficulty in catering for by allowances. Another kind of dimensional change, namely, that due to strains set up in machining, still requires the collection of data from experience and field trials. It is said that distortion from this can be avoided by a thermal relief treatment. One procedure advocated is to machine within 1/32 in. of the finished dimensions, and then to apply the following stress relieving treatment:—

(a) Immerse in water at room temperature for a period of one day for each $\frac{1}{8}$ in. of thickness.
(b) Then bake in a controlled hot-air oven at 70° C. for the same time.

The finish machining is then done to the final limits. It is claimed that this treatment is successful, eliminating warping which is otherwise experienced in sections which are thin relative to the extrusion diameter. However, application over a period of time will show whether this lengthy procedure can be modified or improved upon.

The major use for nylon extrusions in the electrical and instrument industries would seem to be for bearings, gears and cams. Nylon to nylon is an attractive proposition, but nylon to steel (with the latter preferably polished) is satisfactory, or nylon to bronze. Other uses will arise—knobs and handles have been machined from extruded rods, but thin-walled tubes should be useful for covers and protective devices. Many components of course can more economically be moulded in nylon, but plug sleeves (as used on telephone-type jacks and which require to be resilient of high impact resistance) could beneficially use the material cut from extruded tube.

The very low density (specific gravity about 1.13) representing one of the lowest values among plastics, is attractive, but the high coefficient of linear expansion (about 0.0001 per degree Centigrade) is a factor to be noted in many applications.

There is keen interest in applying nylon extrusions at the present time and it is hoped that users will take faithful record of performance against fabricating and design data employed, so that a true assessment of behaviour is ultimately made.

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cylindrical shape and the cavities fitted in a steel-bolster in the normal way. Apart from acrylic artificial teeth, the main applications of these moulds, of which many thousands have been running for years, are nylon gear wheels and worms and similar precision technical components, "3-dimensional" mouldings, reflectors, toys, etc.

The Future of P.V.C.

C. W. Welch, "Plastics"

THE history of p.v.c. was briefly traced, mention being made of the major workers responsible for the development of the material to the production stage. The impact of the past war upon p.v.c. was discussed in some detail, with particular reference to cable manufacture; the point was also made that although the misuse of p.v.c. in the years immediately following the war was responsible for much bad publicity for the plastics industry, nevertheless the war itself had secured for p.v.c. a permanent place in the list of modern materials.

The author then went on to discuss the present situation and, with the facts available, to discuss future developments. The present applications of the use of p.v.c. could be said to be roughly apportioned as follows: flexible products, 100; rigid products, 10; sponge products, 1. In the flexible field a further breakdown could roughly be made as follows: 40% unsupported materials; 40% supported materials and 20% other applications including extrusions of which cable is the large proportion. Although no accurate forecast could be offered for the future development of p.v.c. sponge, it was certainly apparent that rigid applications were as yet only in their infancy. In the flexible field there was still tremendous progress to be made, particularly in respect of extrusion which at the moment is only part of the flexible field. It was therefore not unsafe to offer the view that p.v.c. had an excellent future. The author mentioned a number of major applications which have recently come to the forefront, including flame resistant conveyor belting and foul-weather clothing.

Stress Crazing of Plastics

By J. A. SAUER* and C. C. HSIA*

This paper, first presented at an annual meeting of the A.S.M.E., is reprinted from the November, 1953, issue of the Journal of the Society of the Plastics Industry, Inc., and reviews the effects of various factors in the inception and growth of crazing.

THE onset of crazing in transparent plastics is an undesirable feature that greatly limits their use in engineering applications. Various factors, such as temperature, time, orientation and environment have an influence on the initiation of crazing, but local stress intensity is probably more directly responsible for its occurrence and subsequent propagation than any other factor. The present investigation will therefore be concerned largely with this aspect. although the effect of other variables will be briefly reviewed. Considerable information concerning the cause of crazing and its influence on subsequent behaviour has been reported on several occasions recently in the scientific literature.[1, 2, 3, 4]

Crazing in plastics has been defined as visible mechanical cracks[2] or as submicroscopic failures that result in a noticeable "blushing" of an otherwise transparent material.[4] The term "crazing" has also been used to refer to a type of cracking produced randomly on the surface of unstretched rubber by light in the pressure of ozone.[5] This phenomenon, however, has also been referred to by other terms, such as "sun-cracking," "atmospheric-cracking," "ozone-cracking," or "exposure-cracking" Newton,[6] for example, has described as "exposure-cracking" the fissures formed in the surface of rubber at right angles to the direction of applied stress.

In the field of metallurgy, a closely related phenomenon to crazing is the cracking of metals or alloys when stressed under certain conditions. Stress-corrosion cracking of metals and alloys, and season-cracking of non-ferrous metals, both of which have been intensively studied, are somewhat similar phenomena to crazing in that failure seems to be related to applied or induced stress. In metals, it is well known that cracks or fissures may be produced by rapid changes in temperature, and these are believed due to development of induced thermal stresses. Cracks or local fissures can also be produced in rubber by exposure to ozone, but the phenomenon is greatly accentuated by the presence of an applied stress system.

In all instances where crazing cracks are caused by direct action of an applied stress system, the crazing cracks formed are at right angles to the maximum tensile stress direction. When stress is not directly applied, randomly directed crazing patterns can be produced and have been reported to occur in thermoplastic materials by solvent action, by X-radiation, and by ultra-violet radiation. In all these instances stress does not seem to be directly involved. However, the possibility of the development of quite large localized internal stresses by any of these processes must not be overlooked. If such internal stresses are great enough to exceed the local failure strength of the material crazing will result. Crazing patterns produced both by applied stress and indirectly by solvent action have been reported by Russell[2] and by Maxwell and Rahm.[7]

The precise mechanism whereby solvents such as kerosine or benzene cause crazing cracks to originate and grow is not yet well established. It is generally thought that the effect depends on absorption of the solvent by the material. Absorption softens the surface and may result either in some of the material reaching a critical elongation sooner or in causing a greater share of stress to be carried by surrounding material, thus tending to produce local fissures or openings. Another possibility is that as the absorbed solvent evaporates the surface material will tend to shrink and thereby produce internal tensile stresses sufficient to cause cracks to open up. Regardless of the precise mechanism, the crazing pattern would be expected to differ from that obtained by action of an applied tensile stress in that the cracks or crazing planes should no longer form a regular parallel system, but should be randomly directed. Such, indeed, is the case, as has been shown by Russell for specimens of methyl methacrylate.[8]

For a given applied-stress magnitude, crazing appears to increase with duration of test,[7, 9] and hence with creep elongation. Crazing also increases with increase of temperature. For polystyrene specimens, this effect has been shown by Maxwell and Rahm[7] for various temperatures from 30° to 70° C., for a stress level of 3,600 p.s.i. and for various times from five minutes to half an hour.

Crazing in transparent plastics has also been reported[4] to be related to orientation. On a submicroscopic scale, it is believed that crazing cracks originate as separations of adjacent regions of polymer chains as a direct result of the applied local force exceeding the secondary attractive forces. It is therefore to be expected that in a highly oriented material subject to applied stress in the direction of orientation little or no crazing would occur since the applied forces would tend to draw the chains together rather than to separate them. This effect has been experimentally observed by Bailey[10] and by Cheatham and Dietz.[11] If, however, in the same highly oriented material, the stress were applied at right angles to the direction of orientation, the chain separation should occur more easily and crazing should begin at even low stress levels.

Dependence of Crazing on Applied Stress

Observation of crazing in specimens subjected to applied loading reveals that the observed crazing cracks generally start on the surface and propagate in a direction perpendicular to the direction of maximum tensile stress. If a transparent plastic specimen is subject to uniaxial tension. crazing planes will develop and grow at right angles to the direction of stressing. These crazing planes appear simply as parallel lines when viewed from their side. Micrographs indicating this behaviour for polymethyl methacrylate and polystyrene are shown in Figs. 1 and 2.

In Fig. 1 it will be noted that many crazing cracks originate along the diagonal scratch, indicating the favourable effect of stress concentration on the initiation of crazing. Also numerous fine crazing cracks are found to commence along machine marks. This again indicates that crazing is more easily initiated when a local discontinuity in the surface introduces a high-stress concentration factor and a resulting local stress considerably higher than the average stress in the specimen. This is what occurs at all outside edges of specimens where surface irregularities are unavoidable and hence we should expect that crazing will usually first occur on the external surfaces.

Fig. 2 shows a stress crazing pattern for a section of a polystyrene specimen. The original specimen was ½ in. by ½ in. in cross-

Fig. 1.—Crazing cracks of Lucite, viewed on the moulded surface by transmitted light. Magnification 100X. vertical stress.

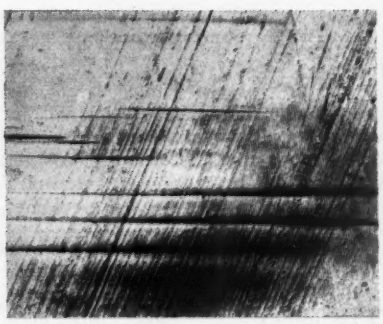

Fig. 2.—Crazing cracks of polystyrene viewed by transmitted light. Magnification 100X, vertical stress.

* Pennsylvania State College.

section and subject to a constant tensile stress in its longitudinal direction. The micrograph shows a transverse view of a longitudinal section taken midway between the vertical surfaces. The inclined lines are polishing marks on the cut surface and the horizontal lines show the edge of the crazing planes. Some of these crazing planes have originated on the outside surface and have propagated to the interior of the specimen. However, new crazing planes not originating on the surface have evidently also been formed.

If a test specimen is subject to a tensile load which is maintained constant until fracture occurs, then its fracture surface will show crazed regions along the external edges and non-crazed or amorphous regions in the interior of the specimen. Fig. 3 shows such a partially crazed ½-in. by ½-in. polymethyl methacrylate specimen. The crazing cracks are clearly visible throughout the reduced gauge length of the test specimen. The relative amounts of crazed and non-crazed regions depend on the duration of test before fractures occurred.

In Fig. 3 also are shown stress-crazing patterns for several polystyrene specimens with different percentages of crazed and amorphous regions. Two distinct types of crack patterns are visible in Fig. 3; one type is the fracture crack system spreading radially outward from the more or less point source (presumably an internal impurity or flow) located in the centre of the circle on the fracture surface, the second type is the much finer crazing crack system spreading normally inward from the surfaces of the specimen. The depth to which these crazing planes extend and the rate of penetration of these planes depends upon the magnitude of the applied stress as well as on its duration, and appropriate quantitative relations for this variation are given later.

The qualitative dependence of crazing on stress magnitude and on duration of test is as follows: for comparable time periods of testing, crazing will increase with increase of applied tensile stress, and for comparable tensile stresses, crazing will increase with increase of time of testing period. Maxwell and Rahm[7] have noted that for thermal-clean stress-free specimens of polystyrene no crazing at all, as measured by reflected light intensity, will occur until a tensile strain of 0.75% is reached, but that the amount of crazing would increase rapidly as the strain was increased beyond that value. The variation of crazing with time for specimens subject to constant load has been reported by Maxwell and Rahm[3] to be linear for times up to several hundred minutes. Sauer Marin and Hsiao[9] have reported that for polystyrene specimens under high-tensile-stress loading fracture occurred shortly after load was applied, with only slight or insignificant amounts of crazing around the edges of the specimen. For lower stress magnitudes, they reported that for some specimens fracture did not occur until hundreds of hours had elapsed and that crazing had by then extended over the entire cross-section.

It should be emphasized that crazing does not depend only on stress and time, but also on the particular material under investigation. For example, for comparable stress and time, as well as surface conditions, crazing cracks in polymethyl methacrylate specimens are usually larger and less dense than those in polystyrene specimens but, at the same time, do not extend as far from the surface. These characteristics may be seen by comparison of the stress crazing patterns of Figs. 1 and 2, and also of Fig. 3.

The effect of crazing on optical distortion can be demonstrated by the double reflection which the crazing cracks produce. This may be seen in Fig. 4, where the specimen on the left has been partly crazed as a result of being subjected to tensile stress for some time and the specimen on the right is unstressed. The double image is caused by the separate reflections arising from the crazed areas lying adjacent to the top and bottom surfaces.

A rather interesting observation reported by Sauer, Marin and Hsiao[9] is that polystyrene specimens may be completely crazed throughout their cross-section and yet continue to carry a considerable amount of load.

A specimen was machined from a larger polystyrene specimen (½ in. by ½ in. in cross-section) which had been subject to a constant tensile stress of approximately 3,000 p.s.i. for approximately 1,000 hours. At the end of this time crazing cracks extended throughout the cross-sectional area. From this larger specimen, a small round specimen was made and tested in tension. Its stress-strain curve, together with that of the original material, is shown in Fig. 5. The data indicate the fully crazed material has approximately the same ductility and somewhat more than one-half the tensile strength of the uncrazed material. There is also shown in Fig. 5 a stress-strain curve for a small specimen taken from the non-crazed portion of a larger tensile-creep specimen.

It is well known[4] that if a compressive rather than a tensile load is applied to a specimen of a transparent high polymer, no crazing will occur. In view of this, it was thought desirable to investigate whether applied compression would be beneficial in eliminating crazing previously produced by tension. A small test specimen was cut from a larger polystyrene specimen previously completely crazed in a tension-creep test. The small test specimen was then compressed and released three different times and finally tested in tension to determine whether any beneficial effects could be noted. The pre-compression seemed to result in a partial healing of the crazing cracks. Probably

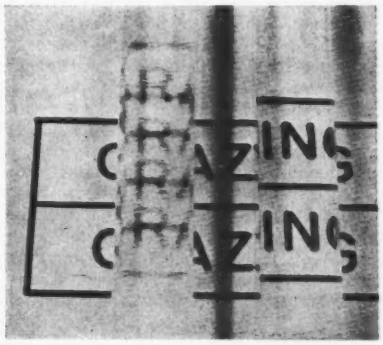

Fig. 4.—Variation of index of refraction of crazed polymethyl methacrylate.

because of the destructive influence of the distortion on the parallelism of the crazing planes and the apparent close-up of the openings between the crazing planes, the specimen at this time was quite clear to the naked eye with little visible signs of crazing. However, when viewed under a light microscope crazing planes could still be seen. Hence, applied compression is at best only partly effective in healing crazing openings produced by tension. Also, if the pre-compressed samples are tested in tension, crazing cracks again open and no increase in strength is observed.

It was stated above that orientation has an effect on crazing. It also has an effect on the stress-strain characteristics and on the ultimate breaking strength. A statistical

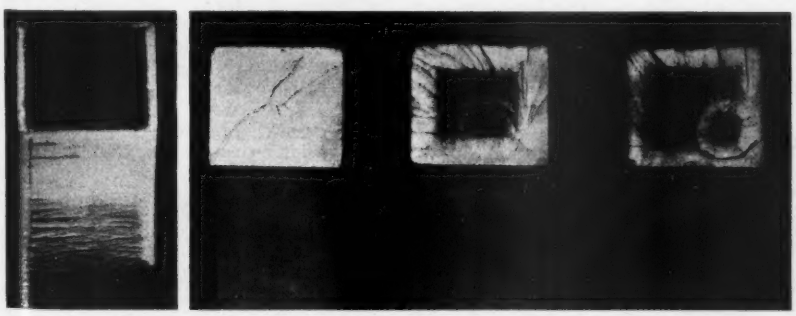

Fig. 3.—(Left) crazed tension creep specimen of polymethyl methacrylate. (Right) Fracture surfaces of crazed tension creep specimens of polystyrene subjected to different stresses and different durations of load application.

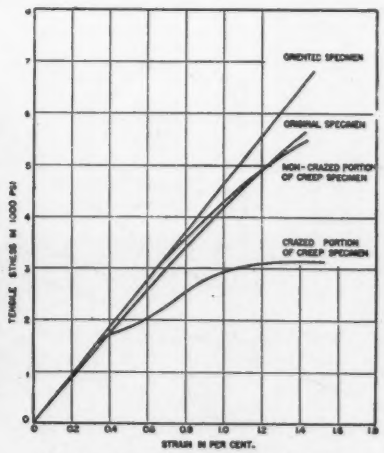

Fig. 5.—Stress-strain curves of polystyrene in tension.

evaluation of the fracture strength for polymers subject to various amounts of orientation has been made by Hsiao and Sauer,[4] and their predicted values check satisfactorily with the experimental data of Bailey[10] and of Cheatham and Dietz.[11] One example of the effect of orientation on strength can be obtained from a comparison of the graphs in Fig. 5 marked "oriented specimen" and "original specimen." The "oriented specimen" was one that had been previously stretch-oriented approximately 300% in each of two biaxial directions. According to the statistical theory of Hsiao and Sauer,[4] its strength should be approximately 25% higher than that of the unoriented sample. The graphs of Fig. 5 indicate that the experimental increase is approximately of this order of magnitude.

The particular "oriented specimen," whose stress-strain behaviour is shown in Fig. 5, is one that was built up of a series of laminated layers of polystyrene—each layer having been biaxially stretch-oriented to the amount mentioned above. The test was conducted at a strain rate of about 190×10^{-6} in./in./sec. and the loading continued until fracture occurred. Despite the short duration of the test (one to two minutes), some crazing occurred and this was clearly visible on the fracture surfaces.

Rate of Propagation of Crazing

As mentioned above, under the action of a maintained tensile stress crazing cracks originate on the external surfaces of the specimen and propagate inward toward the centre. To obtain information on the rate of propagation with time it is necessary to have a continuous measure of the penetration of the crazing front. Since, however, the crazing cracks develop on all four external surfaces of the square specimens and thus destroy visual transparency, it is not easy to measure the inward penetration of the crazing cracks until after the specimen has fractured.

Fortunately, this difficulty can be overcome by use of special coatings. As reported by previous investigators,[4] crazing can be greatly retarded or even prevented from occurring by applying to the outside surfaces some synthetic polymer coating. (For polystyrene, one such coating is a solution consisting essentially of styrene monomer.) To obtain the desired visual advance of the crazing front, one coats two opposite faces of the specimens and leaves the other two faces free. On continued application of a constant tensile load the crazing cracks will then start as usual on the free surfaces and grow inward as time passes. The coated sides, however, will remain essentially craze-free and hence the depth of penetration of the crazing cracks can be easily observed and measured by viewing them from a direction perpendicular to the coated sides.

The cross-section of the specimens was approximately ½ in. by ½ in. and the gauge length was 2 in. long. These specimens were cut from ½-in.-thick polystyrene sheet. On the moulded surfaces about one half of the 2-in.-gauge length section was coated while on the other two sides the transparent coating extended to only about a quarter of the total length; the coating essentially prevented the initiation and growth of crazing from those surfaces on which it was placed, while other uncoated surfaces initiated crazing planes sufficiently intense to reflect light radiation. This method thus permitted the determination of the position of the crazing front from time to time and hence the rate of propagation of crazing could be found. The measurement of the position was made repeatedly by a micrometer at a given location and throughout the 1,000-hour duration of test. The test method, though not, perhaps, as precise as the light-reflection method[2,3] for determining the average amount of crazing developed throughout a given volume, is simpler and more appropriate for determining crazing penetration over long periods of time. A plot of the amount of penetration of crazing against time is given in Fig. 6 for specimens subject to three different stress levels as indicated.

It is interesting to note that these three long-time crazing curves at different stress levels show different amounts of penetration of crazing at the very start of the test. Usually, sharp cracking sounds could be heard soon after the load was applied, which suggests the sudden appearance of crazing and the immediate release of a portion of energy into sound waves. If the first derivatives of these curves with respect to time are plotted against the magnitude of the corresponding stress level, it appears that the rate of displacement of the crazing front varies linearly with the stress as shown in Fig. 7. It is unfortunate that more test points are not available, but within the stress limits indicated the rate of crazing varies with the stress in the following manner

$$D = 1/m\ (\sigma - \sigma_0)$$

where σ is the stress in p.s.i.; m is the slope of this straight line; D is the rate of propagation of crazing front in inches per hour, and σ_0 is a constant measured in stress units. Since the velocity of crazing is thus a linear function of stress, the depth of crazing can be written by integration as

$$D - D_0 = K(\sigma - \sigma_0)\ (t - t_0)$$

where D_0 and t_0 are constant and $K = 1/m$. For polystyrene $D_0 = -0.015$ in., $K = 0.851 \times 10^{-7}$ in./hr./p.s.i., $\sigma = 1{,}670$ p.s.i., and $t_0 = -400$ hours.

Thus, within the limited range of stresses, as indicated in Fig. 7, the depth of crazing may be expressed as a linear function of both stress magnitude and time. It is questionable whether the above equations can be extended to much lower stresses, but their implication that the rate of propagation of crazing goes to zero for some limiting stress value does seem to be in general agreement with experimental results.[9] It is also difficult to investigate the above relation for much higher stresses than 3,500 p.s.i. as the specimen tends to fracture in much shorter time periods and thus not much data on crazing can be taken. Such short-time fractures are frequently caused by obvious flaws, which result in high local stress intensities. The actual fracture cracks, as distinct from the crazing cracks, very frequently start from some point inside the specimen and then extend rapidly radially outward.

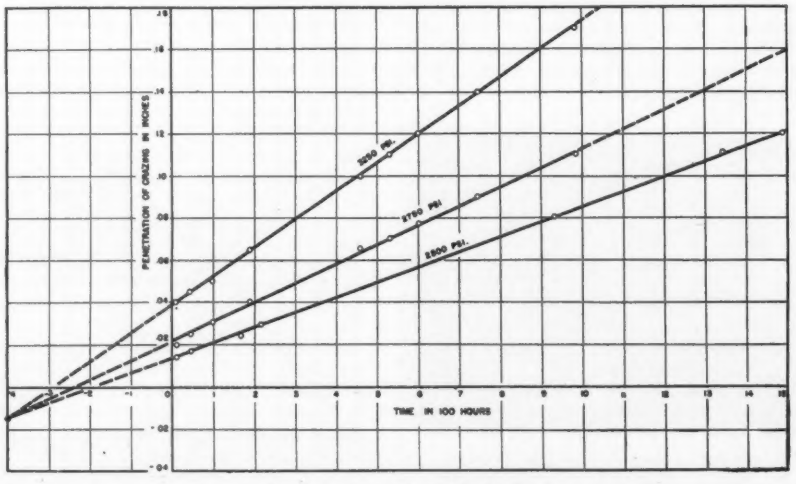

Fig. 6. Long time crazing curves of polystyrene.

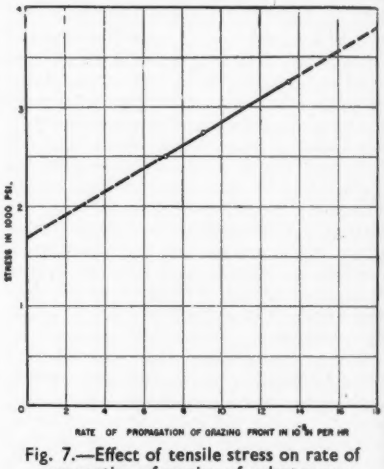

Fig. 7.—Effect of tensile stress on rate of propagation of crazing of polystyrene.

Design Implications of Crazing

The development of crazing in stressed transparent plastics is for the most part a highly undesirable occurrence. In such applications as transparent enclosures on aircraft, transparent instrument panels, and as insulators in electronic apparatus, the

(*Continued on page 32*)

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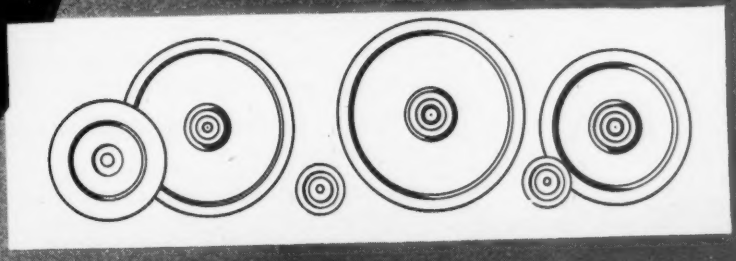

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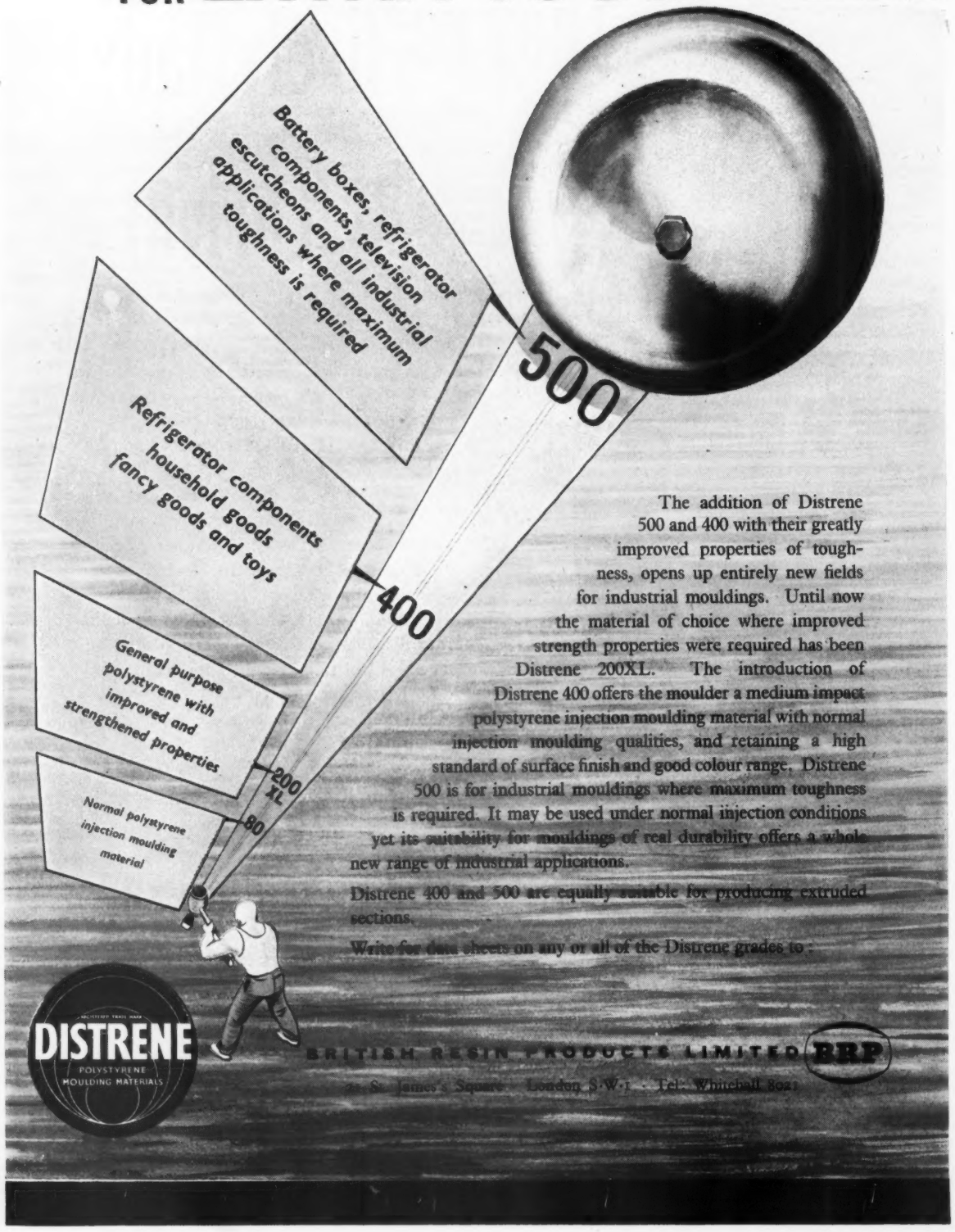
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PATENT REVIEW

The following abstracts have been made rom specifications at the Patent Office, with the permission of the Controller of H.M. Stationery Office. The country of origin for Convention Applications is shown in parentheses. Complete specifications can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 2s. 8d. each (including postage).

B.P. 695,700. Bonded magnetic cores and process for producing them. To: Westinghouse Electric International Co. (U.S.A.).

The spaces between the laminations of the assembled core are impregnated with a low-viscosity resin solution, then wrapped in glassfibre tapes, finally coated with a resinous coat.

B.P. 695,715. Self-locking nuts and the like. B. A. Parr.

An insert is used of an extruded rectangular section of nylon or polyvinyl chloride reinforced by an internal wire.

B.P. 695,790. Securing adhesion between vinyl-based polymers or copolymers and metal surfaces. Horwitch Smith and Co., Ltd., F. H. Smith.

B.P. 695,798. Manufacture of thick films of hygroscopic, non-fibrous, organic material. G. D. Bond, A. E. King, D. Samways. To: British Cellophane, Ltd.

Thin, single films are laminated using a coating of a liquid aqueous adhesive between each pair of surfaces.

B.P. 695,810. Synthetic resin composition. A. R. Burgess. To: I.C.I., Ltd.

Improved weather (light) stability is obtained by incorporating up to 10% of a chelate compound of copper or nickel with an aromatic o-hydroxy azo compound.

B.P. 695,826. Production of porous materials from high molecular weight polymerization products. To: Badische Anilin and Soda-Fabrik (I. G. Farbenindustrie AG.) (Germany).

In a monomeric polymerizable substance, a volatile organic liquid is dispersed with subsequent polymerization and heat treatment. For padding material, shock absorbers, vibration damping equipment, insulation.

B.P. 695,839. Containers. J. M. Jackson. To: Metal Box Co., Ltd.

A polyvinyl chloride ("Welvic") seal is an apertured cap which is self-sealing to punctures formed by inserting a hypodermic needle.

B.P. 695,865. Closure cap for containers. B. Strong, E. Shipton and Co., Ltd.

Screw cap of "Alkathene" with inwardly projecting central portion.

B.P. 695,885. Motor vehicle licence holder. J. Kee, Clydesmuir Precision and General Engineering Co., Ltd.

B.P. 695,904. Devices for manufacturing flexible containers from synthetic plastic materials. To: Unitubo SA. (Switzerland).

Polyethylene granules are heated in a cylinder, pressed from the cylinder into a mould around a punch and cooled. The moulded tube is then disengaged by rotation from the thread-forming moulding head.

B.P. 695,966. Method and apparatus for heating, melting and hot-spraying thermoplastic materials. W. Kopperschmidt. (Germany).

The material is melted in a pre-heating vessel forming a first zone, heated to a high temperature in a second zone, then up to working temperature within a pipe coil forming a third zone.

B.P. 696,026. Hair curling devices. To: Gillette Safety Razor Co., (U.S.A.)

The device is formed of two moulded plastic parts assembled by pressing the parts together.

B.P. 696,036. Process for colouring plastics. H. P. W. Huggill, A. Parkinson, R. Deverell-Smith. To: I.C.I., Ltd.

Copper octo-(4 : 5)-phenol-phthalocyanine is mixed with the plastics material to give transparent yellowish-green shades of good fastness.

B.P. 696,063. Artificial teeth and method and apparatus for forming the same. To: Dentists' Supply Co. of New York (U.S.A.).

A pre-moulded thermoplastic synthetic resin tooth is subjected to compression by hydraulic pressure in a finishing mould while sufficiently heated to soften the material.

B.P. 696,066. Polymers. J. G. N. Drewitt, J. Downing. To: British Celanese, Ltd.

Production of copolymers of vinylidene chloride with methacrylonitrile.

B.P. 696,078. Spectacles. S. S. Unger, G. J. Adcock, Unger and Adcock, Ltd.

Special plastic and metal frame for a marksman to adjust the lenses to a desired angle.

B.P. 696,090. Curtain suspension means. Roanoid Plastics, Ltd. H. H. Smith.

B.P. 696,183. Signs, display devices and the like. L. Meijer.

A block carrying the display in depth is pressed onto one face of a heated translucent thermoplastic sheet. The same block is used to reproduce the display on a sheet of flexible translucent material. The sheet is then filled in with luminescent material and attached to the back of the embossed thermoplastic sheet in register with the relief display.

B.P. 696,207. Electrical resistance network for solving physical problems. S. C. Redshaw. To: Boulton Paul Aircraft, Ltd.

A network of conducting elements is printed on an insulating (resin-impregnated fabric) base.

B.P. 696,209. Coatings for glass envelopes and the like. Allen West and Co., Ltd., E. B. Babler.

The glass envelope of a mercury switch is warmed and dipped in polyvinyl chloride paste. The coating is polymerized at 150°C. It is 0.25 to 0.5 mm. thick and translucent.

B.P. 696,270. Insulating support or clamp for holding cables, wires and other electric conductors. W. Sihn, Fa. Wilhelm Sihn. (Germany).

The clamping member is injection-moulded from any suitable flexible plastic.

B.P. 696,321. Polytetrafluoroethylene organosols. To: E. I. du Pont de Nemours and Co. (U.S.A.).

B.P. 696,322. Adhesive composition. A. L. Hatfield, H. P. Owen. To: B. F. Goodrich Co. (U.S.A.).

A pressure-sensitive adhesive is produced from a soft, low-molecular weight polymer of a butadiene—1,3 hydrocarbon, an acrylic nitrile and minor amounts of rosin alcohol.

B.P. 696,487. Plastic moulding machine and mould therefor. To: A.C.I. Plastics Pty. Ltd. (Australia).

The mould for the compression moulding of thermosetting and thermoplastic material is built up from a ring with apertures to be engaged by a downward moving upper plug-like mould member co-operating with a lower female mould member which moves up. The female mould has a downwardly extending cavity holding the moulding material. Both mould members are withdrawn simultaneously after the operation. The disc can then be turned to remove the moulded article while another aperture is located between the upper and lower mould members.

B.P. 696,488. Apparatus for performing finishing operations on moulded articles. To: A.C.I. Plastics Proprietary Ltd. (Australia).

A flash removing device is incorporated in the moulding machine.

B.P. 696,534. Moulding of thermosetting and/or thermoplastic materials. To: A.C.I. Plastics Proprietary Ltd. (Australia).

After applying pressure, the mould is vented simultaneously on opposite sides of the moulded article.

B.P. 696,585. Alkyd resins and varnishes comprising the same. To: Dow Chemical Co. (U.S.A.).

B.P. 696,607. Method of embossing or doming cardboard. A. A. Mijnlief.

Cardboard, "Cellophane," etc., is caused to expand, attached to the edge of the blank, then caused to contract.

B.P. 696,622. Method of cleaning articles. To: Dr. Alexander Warker Ges. fuer Elektrochemische Industrie G.m.b.H. (Germany).

Polyvinyl chloride particles of 0.5 to 1 mm. diameter are incorporated in trichlorethylene or the like. After rinsing, the treated article is free from any previously adhering particles.

B.P. 696,662. Bottle capping means. J. R. L. Martin. To: Coty Ltd.

B.P. 696,689. Containers. W. K. Archer, P. A. Marchant. To: Injection Molding Co.

The container has a double wall with a projecting neck for a screw cap with an annular flange corresponding to the shoulder formed between the two walls underneath the neck.

B.P. 696,695. Artificial femoral head. H. G. Drew.

The head is made of "Perspex."

B.P. 696,722. Method for making stringer tapes for slide fasteners. N. J. Poux. To: Talon Inc. (U.S.A.).

A strip of plastics material (extruded vinyl, polyvinyl, etc.) has a beaded edge formed by parts permanently attached thereto (a pair of cords adhesively secured to opposite sides of the strip).

B.P. 696,765. Screw-threaded fastening devices. Elastic Stop Nut Corp. (U.S.A.).

The locking insert is formed by injection moulding from thermoplastic material such as cellulose derivatives, vinyl and styrene derivatives, nylon (preferred material).

B.P. 696,767. Switch bases for electric lamp holders. British Electric Lamps, Ltd., V. S. R. Dixon.

The base plate is moulded from thermoplastic or thermosetting material (cellulose acetate).

B.P. 696,798. Jumpers for domestic water taps and the like. I. C. Tannock, H. A. Lindfield. To: Plastomatic Ltd.

The part-spherical head is moulded integrally with the stem from polythene.

B.P. 696,834. Radar reflector systems for use on buoys and other floating structures. N. M. Rust. To: Marconi's Wireless Telegraph Co., Ltd.

Each unit is a metal-coated solid body of "foamed" ebonite ("Onazote") providing a ring of corner reflectors.

B.P. 696,854. Production of ornamental or other memorials. N. Douce.

The ashes are incorporated in the moulding or casting.

B.P. 696,875. Container cap remover. R. H. Williams. To: White Cap Co.

B.P. 696,896. Crystal valves. British Thomson-Houston Co., Ltd., D. J. Newman.

Moulded around the electrodes is a casing of a synthetic resin.

B.P. 696,904. Crystal valves. D. J. Newman, T. H. Kinman. To: British Thomson-Houston Co., Ltd.

Acrylic resins and solid polymers of ethylene are suitable for completing the enclosure of the valve.

B.P. 696,914. Holders for electric lamps. C. W. Wood. To: British Thomson-Houston Co., Ltd.

A sleeve of p.v.c. is used as a weather seal for outdoor (sodium discharge) lanterns.

B.P. 696,922. Electrical condenser. G. R. S. Charles.

A polyethylene casing moulded in two parts with inset metal bushes as housing.

B.P. 696,924. Piano actions. A. Renn.

Hammer butt, balance hammer and connecting dowel are formed integrally, e.g., by injection moulding, of plastics material instead of wood.

B.P. 696,946. Egg cups. J. R. Huckfield. To: Perry Bevan and Co., Ltd.

B.P. 696,994. Preparation of colourless, colour-stable bulk polymers of methyl α-chloracrylate. To: General Anilin and Film Corp. (U.S.A.).

B.P. 696,016. Indicating device for use with milk bottles or the like. D. R. Rickford.

B.P. 697,043. Leak-proof dispenser for fluids under pressure. To: Connecticut Chemical Research Corp. (U.S.A.).

The valve body is integral with the container, whose size is limited only to the degree imposed by compression and/or extrusion methods.

B.P. 697,044. Machine for forming sealed plastics containers from deformable material in sheet form. D. H. Pollit, P. H. Hawe.

The containers are formed in a bath of liquid for seating the sheets in the mould cavities prior to sealing.

B.P. 697,058. Coat hanger. Universal Injection Plastics, Ltd., J. Johnston.

Made in one piece in a two-part mould, it is provided with a cage for retaining moth balls.

B.P. 697,110. Manufacture of plastics sheet material. J. C. McCarthy, L. Eaby. To: Armstrong Cork Co. (U.S.A.).

"Vinylite" tiles (asphalt or other tiles) may be made with the appearance of marble by feeding small strips containing mottling colour particles to the nip of sheeting calender rolls the colour particles forming striated lines on the edge surfaces of the cut strips and producing marble graining when passed through the rolls.

B.P. 697,160. Games of chance. L. R. Pattee.

Polyhedrons moulded in plastic with letters in intaglio.

B.P. 697,181. Instruments for measuring radiation. Tesla NP, A. Kuhn (Czechoslovakia).

Ionization chamber walls are of "Bakelite" or aluminium.

B.P. 697,246. Plastics compositions. E. R. Laning. To: Stokes Moulded Products Inc.

Storage battery containers from synthetic rubber and powdered anthracite, sulphur and plasticizer.

B.P. 697,250. Multi-cavity moulds. J. A. W. Mills, H. A. Drew, A. D. Chesmer. To: Dowty Seals, Ltd.

A number of shaped annuli are arranged coaxially as a stack with an annular entry throat from the central space.

B.P. 697,255. Injection moulding and articles produced thereby. E. V. Wagner.

Pen or pencil caps are made in two stages. In the second stage, gaps produced in the first stage due to the support of the core pin are filled with injected material.

B.P. 697,273. Injection-moulding and extrusion apparatus. To: British Thomson-Houston Co., Ltd. (U.S.A.).

The screw-threaded plunger has a cylindrical and smooth forward end sliding through an opening in the pressing head adjacent the inner nozzle end.

B.P. 697,289. Process for polymerizing vinyl-type compounds and polymers produced thereby. N. V. de Bataafsche Petroleum Maatschappij (U.S.A.).

B.P. 697,316. Rotary moulding machines. E. E. Heinzelman. To: Armstrong Cork Co. (U.S.A.).

A moulding composition, e.g., Bakelite (powder or pill), is charged consecutively into moulds arranged on a rotary table. To the closed mould pressure is applied during further rotation by a cam device co-operating with counteracting bellows under the mould to control the pressure. After rotation through about 70% of the circumference (curing cycle), the mould is opened and the article expelled through a chute.

B.P. 697,322. Production of films of hygroscopic, non-fibrous, organic material. W. Berry, C. R. Oswin, E. G. Sanderson. To: British Cellophane, Ltd.

B.P. 697,326. Manufacture of hollow articles from plastic materials. J. S. Walker, Fraser and Glass, Ltd.

For making containers or toys of solid polyethylene, the material is extruded downward in the form of a tube over the vertical nozzle of a compressed-air line. The mould is closed while the material is still plastic, the upper end of the tube sealed and air applied to expand the material in the mould.

B.P. 697,337. Tubes. L. J. Moncrief. To: British Celanese, Ltd.

A strip of cellulose acetate (or other thermoplastic materials) while travelling longitudinally is bent transversely so that its edges overlap, adhesive being applied to one of the edges. The seam is subjected to pressure between a driven roll and an idler roll. The cylindrical tube may be converted to elliptical or polygonal shape by heating and expanding.

STRESS CRAZING OF PLASTICS

(*Continued from page 30*)

initiation of crazing is cause for alarm, either because of loss of transparency, loss of mechanical strength, or loss of dielectric properties due to moisture absorption in the crazing openings. Also, since crazing once started will continue to increase without increase of load magnitude, it is well to avoid its consequences by taking every precaution to avoid its inception.

Conclusion

In applications where the plastic part may be subject to tensile stress in varying directions, full annealing of the transparent plastic sheets is highly desirable, as, in this way, the material can be made more nearly isotropic. On the other hand, if the plastic part is to be used only under uniaxial tension, then higher working stresses can be obtained, without danger of crazing, by use of highly oriented material. Essentially, the reason is that in the oriented state all the molecular chains tend to align in the direction of orientation and crazing which is thought to be a result of lateral separation of adjacent chains[4] can then not occur. Crazing will, of course, occur in oriented materials and at low stress values if transverse tensile, rather than axial tensile, stress is applied. If, therefore, the intended application is such that there is a probability of lateral as well as longitudinal tensile stresses occurring, then the isotropic annealed state is preferable to the highly oriented state.

The authors wish to thank Professor D. A. Kribs, of the Pennsylvania State College, for his help in making most of the crazing micrographs, and also express their appreciation to the Office of Naval Research for financial support.

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(1) W. B. Klemperer, *Stress Pattern Crazing*, Theodore von Karman Anniversary Volume 1951, p. 328. **(2)** E. W. Russell, Studies on Polymethyl Methacrylate, Part III, Crazing Effects, *Chem. Report* 447, Royal Aircraft Establishment, Aug. 1948. **(3)** B. Maxwell and L. F. Rahm, Factors Affecting the Crazing of Polystyrene, *Plastics Laboratory Technical Report* 14*B*, Princeton University, May 1949. **(4)** C. C. Hsiao and J. A. Sauer, on Crazing of Linear High Polymers, *Journal of Applied Physics*, Vol. 21, Nov. 1950, p. 1071. **(5)** R. E. Morris, R. R. James and Werkenthin, Sunlight and Accelerated Light Aging of Synthetic Rubbers, *Rubber Age* (*N.Y.*), Vol. 51, 1942, p. 205. **(6)** R. G. Newton, Mechanism of Exposure-Cracking of Rubbers with a Review of the Influence of Ozone, *Rubber Chem. and Tech.*, Vol. 18 1945, p. 504. **(7)** B. Maxwell and L. F. Rahm, The Rheological Properties of Polystyrene Below 80° C, *Ind. and Eng. Chem.*, Vol. 41, Sept. 1949, p. 1988. **(8)** E. W. Russell, Crazing of Cast Polymethyl Methacrylate, *Nature*, No. 4186, Vol. 165, Jan. 21, 1950, London. **(9)** J. A. Sauer, J. Marin and C. C. Hsiao, Creep and Damping Properties of Polystyrene, *Journal of Applied Physics*, Vol. 20, No. 6, June, 1949. **(10)** J. Bailey, Stretch Orientation of Styrene and its Interesting Results, *India Rubber World*, May 1948. **(11)** R. G. Cheatham and A. G. H. Dietz, Effects of Orientation on the Mechanical Properties of Polystrene, *Trans. ASME*, Jan., 1952.

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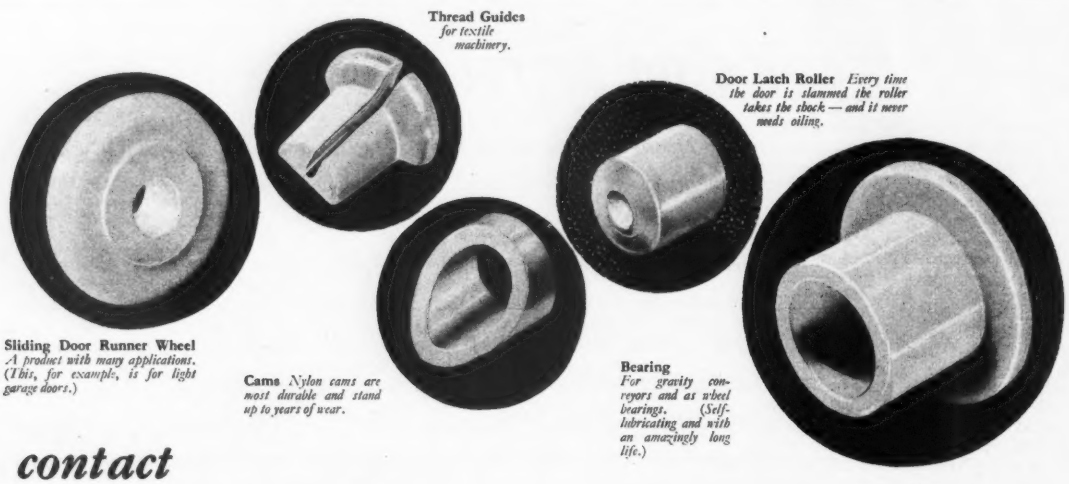

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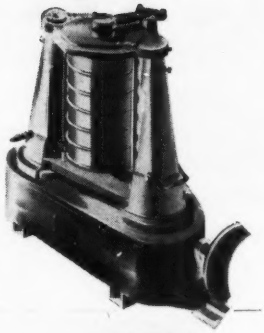

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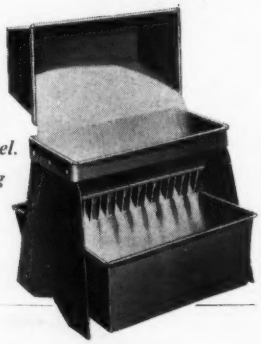

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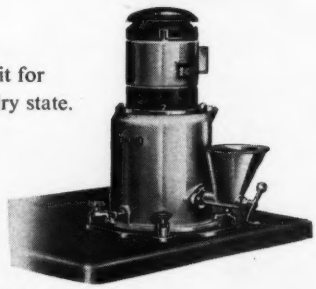

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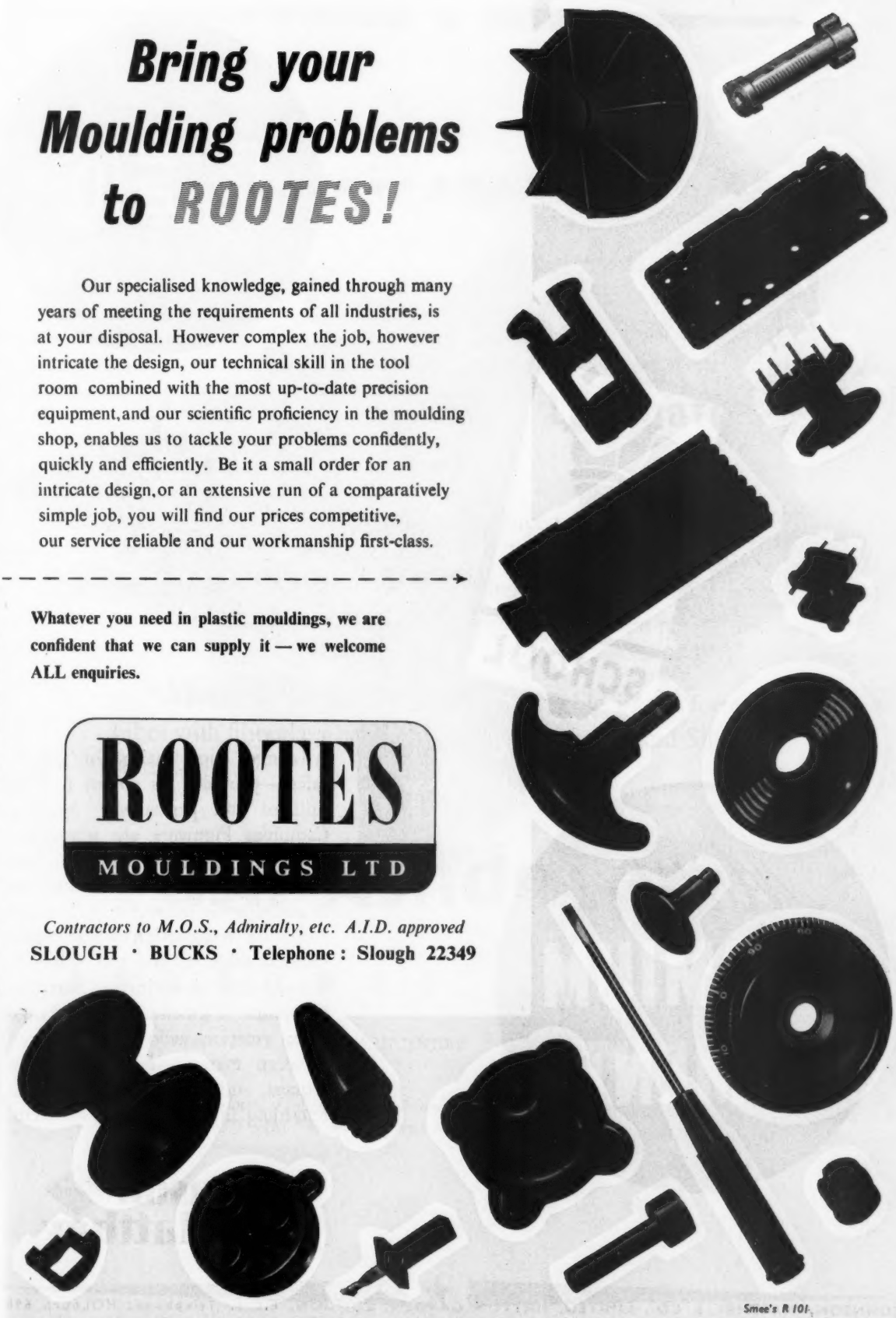

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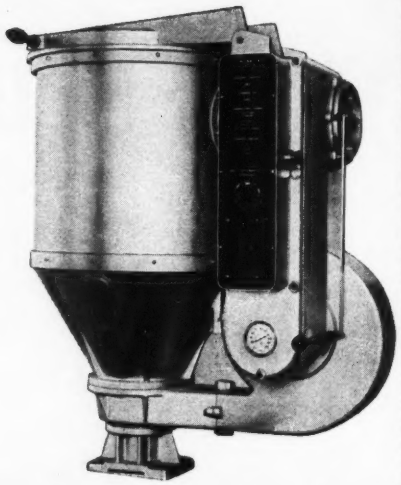
Pre-dryer and Pre-heater

for DIRECT MOUNTING on INJECTION-MOULDING MACHINES and for use with every type of injection-moulding material.



The **Continator** is a complete unit, of small dimensions. mounted in replacement of the normal Hopper. It eliminates drying cabinets and trays, thus saving time and labour, and economises on material by direct feed from the original container. It is made in lightweight metal, has no painted parts, and is fitted with a powerful magnetic separator.

The **Continator** is available in two standard sizes :—
No. 100/5, suitable for all machines of up to 4-oz. capacity.
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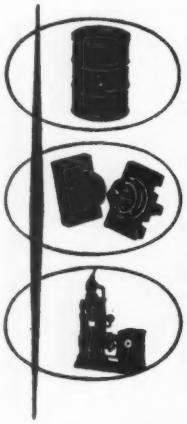

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Injection and Compression Moulds. Jigs and tools for metal components.

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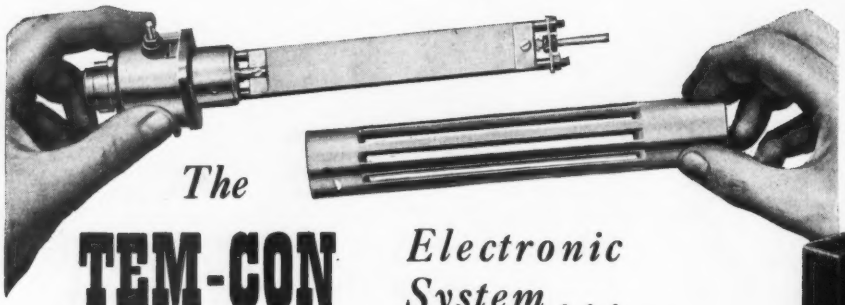

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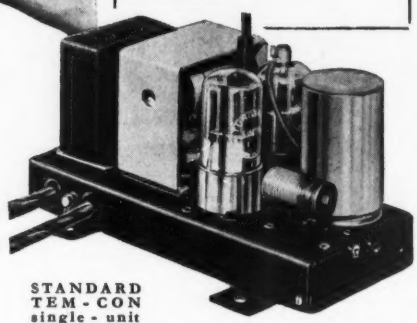

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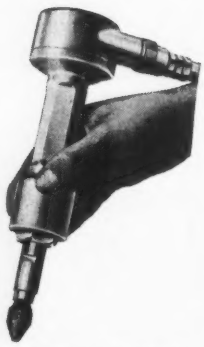

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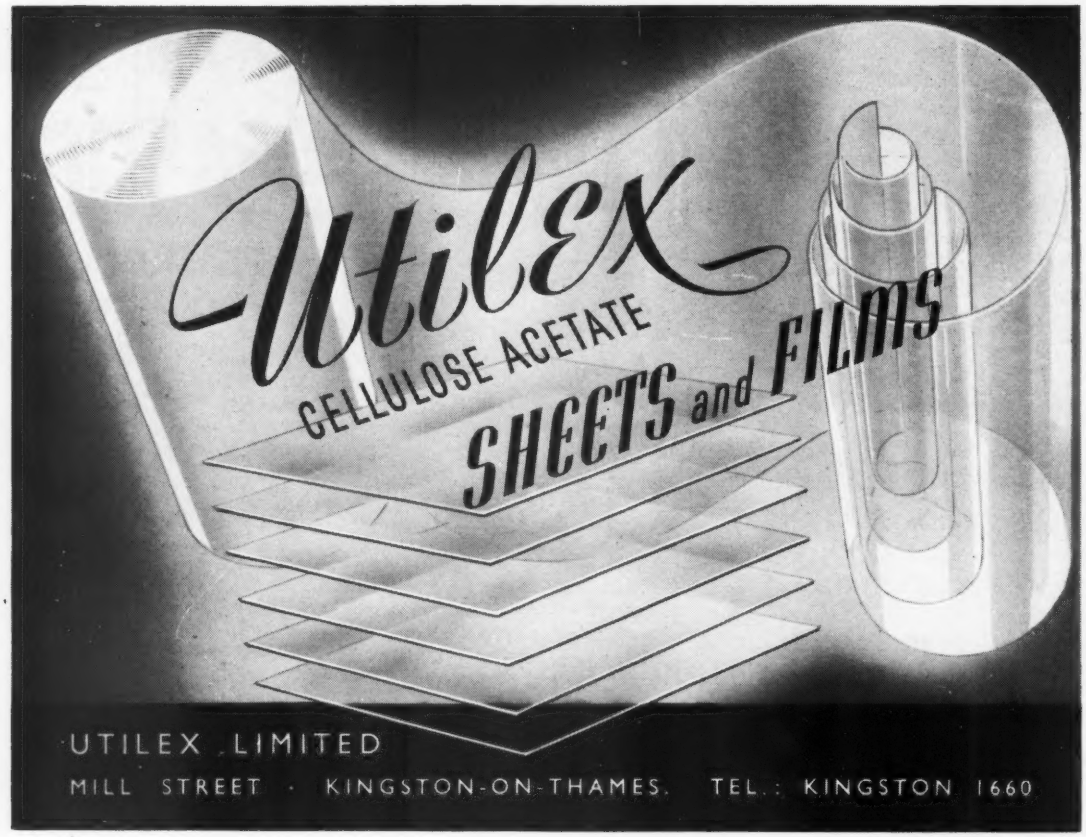

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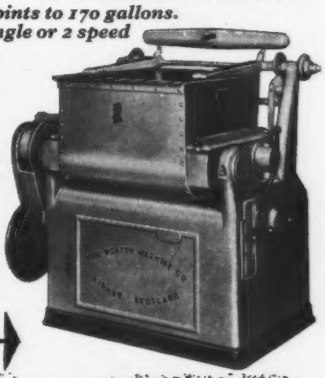

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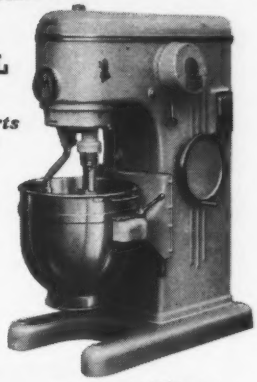

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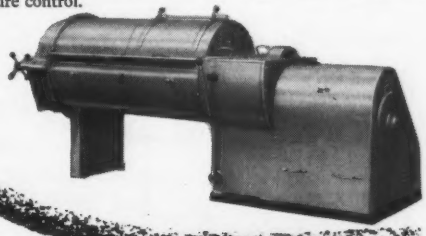

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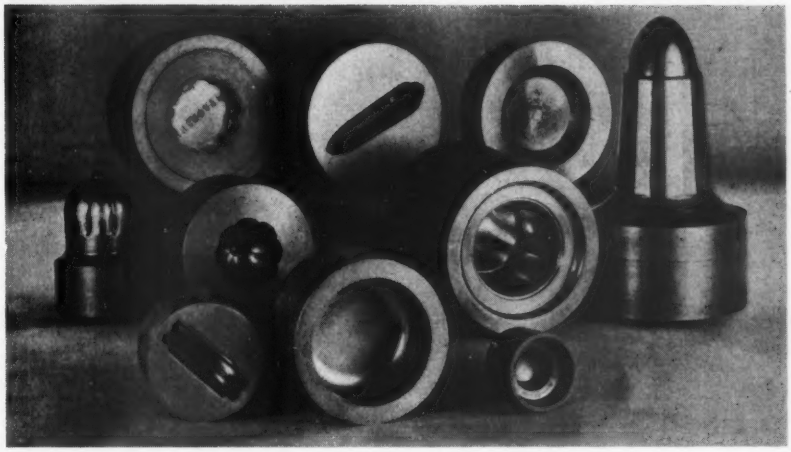

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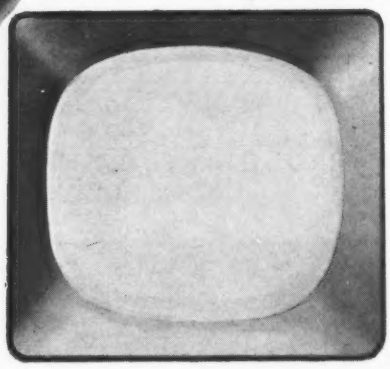

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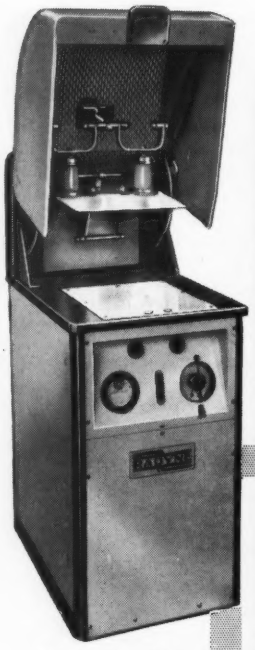

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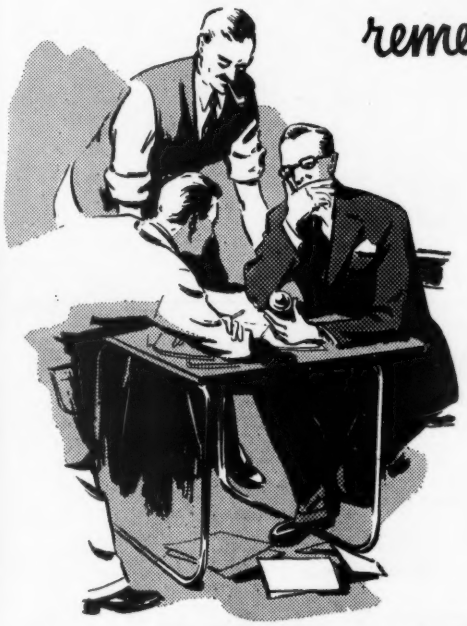

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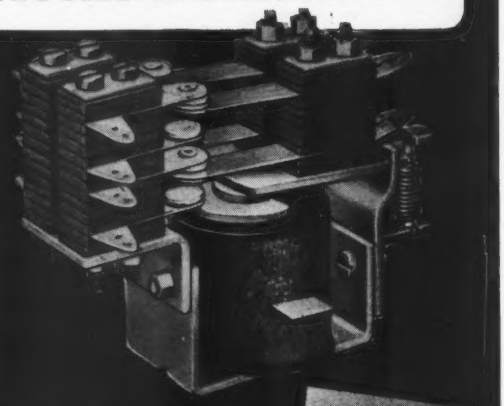

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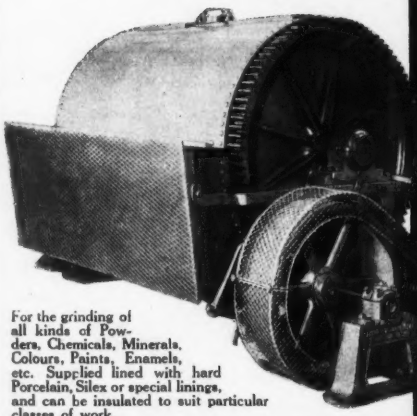

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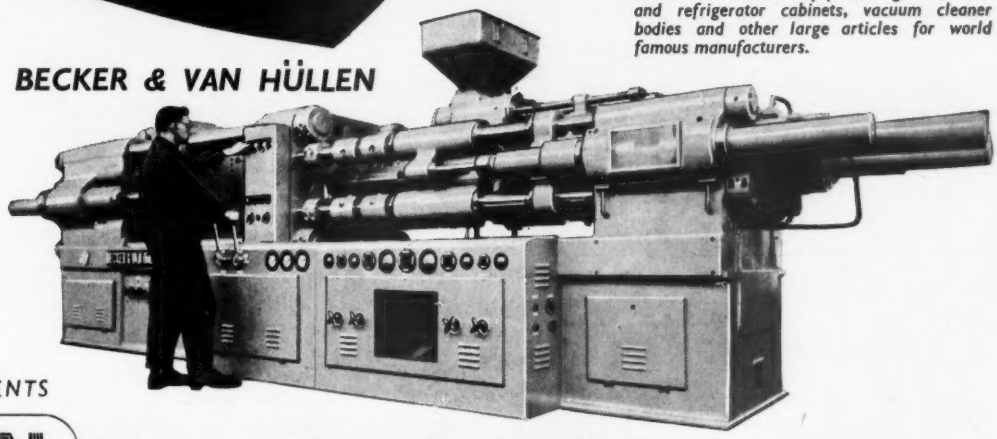

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BY ORDER of the Receiver for Sale as a going concern, the business and assets of a South London company engaged in the manufacture of laminated plastics and insulation materials. Also engineering contractors to the aircraft industry and various Government Departments. Including the plant, stock, work-in-progress, licences, and manufacturing rights of proprietary articles. To an interested party requiring the necessary accommodation, the long leasehold factory, containing an approximate floor space of up to 90,000 sq. ft., is available for letting or for sale. Full particulars of Henry Butcher and Co. (R.F.H. Dept.), 73 Chancery Lane, London, W.C.2. Holborn 8411 (8 lines). 198-37

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ALTERNATORS. Diesel sets, electric motors, switch gear, transmission equipment, fluorescent lighting and industrial fittings ex stock, keen prices. Contact G. L. Murphy, Ltd., Menston, near Leeds. zzz-210

HYDRAULIC. Frazer Mono-radial pumps, new and second-hand, in stock. Thompson and Son (Millwall), Ltd., Cuba St., London, E.14. East 1844. zzz-440

FOR SALE. Hydraulic two-column plastics press with a working platen area of 8-in. by 8-in. and a maximum daylight of 12-in. and a hydraulic lift of 6-in. Fitted with electrical hot plates and manufactured by Apex Construction Co. Ideal for laboratory or pilot plant works. Box P962, care of "Plastics." 198-1033

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Seventeen 1 ft. 2 in. dia. by 3 ft. 6 in. long, pressure 2,000 lb. sq. in.
Two 8 in. dia. by 8 ft. long, pressure 3,600 lb. sq. in.
GEORGE COHEN SONS AND CO., LTD.,
58 WOOD LANE, LONDON, W.12.
Phone, Shepherd's Bush 2070.
198-1

ONE—6-in. GERMAN MIXER, complete with variable speed motor, electrical equipment and jacket lifting gear (little used).
One—½-oz. hand-operated injection machine.
One—1-lb. Baker Perkins mixer (new condition).
One—½-lb. Baker Perkins mixer mounted on aluminium clad bench complete with motor, switch gear and variable speed drive.
One—"Dowty" hydraulic pump unit complete with 5 h.p. motor and switch gear, pump delivery three gallons per minute at 3,000 p.s.i., variable pressure control.
Can be seen by appointment. Box P9712, care of "Plastics." 198-x1933

FOR SALE, 2-oz. Hupfield injection moulding machine, in perfect condition. Can be seen working by appointment. Rollrite Plastics, Hereford. 198-x2939

IZOD-IMPACT TESTING APPARATUS, Avery, almost unused, price £60. Box N 971, 110 Old Broad St., London, E.C.2. 198-9

SIXTEEN 200-TON EX-M.o.S. UPSTROKE HYDRAULIC PRESSES. 10¾-in. ram, 15-in. stroke, 6¼-in. columns, table 25 in. by 15 in., all-steel head.
Sixteen 200-ton ex-M.o.S. downstroke hydraulic presses, 10⅛-in. ram, 15-in. stroke, 6¼-in. columns, table 25 in. by 15 in., all-steel head.
Eight 200-ton H.E.C. double-ram upstroke and downstroke hydraulic presses, 10¾-in. and 10⅛-in. rams, each 15-in. stroke, 6¼-in. columns, table 25 in. by 15 in.
One 150-200-ton Lehman upstroke hydraulic press, 14-in. ram. 5-in. columns, 48-in. daylight, 24 in. by 17-in. table, 150 tons at 2,240 p.s.i., 200 tons at 5,000 p.s.i.
Forty-five Frazer Mono radial hydraulic pumps, motor driven, 3 h.p., 3-50-400, 0 to 6½ g.p.m. variable, 750 p.s.i., with bedplate and oil tank, as new.
Also other pumps, accumulators, etc, small presses 1 to 20 tons, control gear, etc.
Hodson and Co. (Machinery), Ltd., Spring Mills, Tottington, near Bury, Lancs. Phone, Tottington 123-4. 198-4

Machinery, Tools and Plant (contd.)

FOR SALE, one R.C.65 extruder by R. H. Windsor, Ltd., very little used, price £1,100. Box P9820, care of "Plastics." 198-28

HYDRAULIC PRESSES.

400-tons UPSTROKE by Greenwood and Batley. Ram 16-in. dia. x 30-in. stroke. Four columns distance between 22 in. x 17¾ in., moving table has a working area of 3 ft. x 17 in. Daylight 3 ft. 6 in. W.P. 2 tons sq. in.
250-tons UPSTROKE by Henry Berry, 15-in. dia. ram x 20-in. stroke. Four columns, distance between 23½ in. x 11½ in. Fully guided moving table 23½ in. x 22 in. Daylight 20 in. W.P. 1½ tons sq. in.
200-tons DOWNSTROKE by Hydraulic Engineering Co., Ltd. Piston type, double acting ram 4½-in. dia. x 13-in. dia. rod x 12-in. stroke. Steel fabricated frame with detachable tee slotted table 30 in. x 21 in. Daylight 30 in. Below fixed table is a double-acting, piston-type ejector ram 3⅞-in. dia. x 4½-in. stroke. Press arranged for prefilling and constant pressure return, with self-contained high- and low-pressure pump. Motorized 415/3/50.
150-tons DOWNSTROKE by Francis Shaw. Main ram 14-in. dia. x 26-in. stroke. Four columns 4-in. dia., with distance between of 28 in. x 12 in. Table 28 in. x 26½ in. Daylight 28 in. Fully guided moving table returned by two 3¼-in. dia. push-back rams. Fitted with transfer moulding or ejector ram, 4½-in. dia. x 12-in. stroke. Table has a 4½-in. dia. hole in centre. Arranged for automatic prefilling. W.P. 1 ton sq. in.
Two 120-tons DOWNSTROKE by Hydraulic Engineering Co. Double-acting, piston-type ram, 8¾-in. dia. x 7⅝-in. dia. rod x 14-in. stroke. Steel fabricated frame. Fixed and moving tables 24 in. x 21 in., detachable and provided with tee slots. Daylight 24 in. Fitted below fixed table is a double-acting, piston-type ejector ram 3-in. dia. x 2⅝-in. rod by 4½-in. stroke. Self-contained pump, motorized 400/440/3/50.
100-tons DOWNSTROKE by T. H. and J. Daniels. Main ram 12-in. dia. x 16-in. stroke. Four columns 3½-in. dia., with distance between of 20½ in. x 10¾ in. Tee slotted, fixed and moving tables each fitted with 20-in. square electric platen. Daylight between platens 20 in. Fully guided table returned by two 3-in. dia. push-back rams, with hydraulic "hanger-bar" ejector, prefil valve and pumping equipment by Towler Bros., motorized 1½ h.p., 400/440/3/50.
GEORGE COHEN SONS AND CO., LTD.,
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LONDON, W.12.
Phone, Shepherd's Bush 2070.
And
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35-TON HYDRAULIC HAND-OPERATED FOUR-COLUMN COBORN PRESS, take 12-in. by 12-in. hot-plates, Tangye 2-speed pump, quick adjustment of centre platen by hand wheel, good condition. Offers. Box P9818, care of "Plastics." 198-22

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WANTED. Laboratory mixing mill (small), good condition. Two (2) rolls 2 in. by 6 in., to withstand about 100 p.s.i. of steam, water-cooled. Roll speeds—obtainable by interchangeable roller and wheels. Back roll, 17.03 r.p.m., 17.03 r.p.m., 17.03 r.p.m.; front roll, 17.03 r.p.m., 15.03 r.p.m., 19.30 r.p.m., or near above specification. Write Box P.145, care of 191 Gresham House, E.C.2. 198-14

HYDRAULIC OR PNEUMATIC PRESS required. Must be capable of thermo plastic mouldings 70-in. long and at least 24-in. wide.
Advertiser also requires hand presses for same type of work, capacity approximately 29 in. by 23 in. Write Box P9622, care of "Plastics." 198-1111

COMPRESSION MOULDING TOOLS wanted. Send details of your surplus, obsolete and redundant moulding tools. Box P986, care of "Plastics." 200-1039

SECOND-HAND "PECO" INJECTION MOULDING MACHINE, 6-ox. or 8-oz., required. State age, price, quick delivery. Box P9823, care of "Plastics." 198-25

WANTED. One inch screw extruder and also laboratory hot rolls, size 12-in. by 6-in. or 8-in. S. and J. Walsh (Plastics), Ltd., St. Lawrence Mills, Great Harwood, Lancs. Phone, Gt. Harwood 3121. 198-34

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Production Capacity (contd.)

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ERLANOS, LTD., 93 Aldersgate St., E.C. (Monarch 4686), require Perspex and cellulose offcuts and scrap, clear and coloured, highest prices paid. 206-3330

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ALL PLASTIC SCRAP
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BEST CASH PAYMENTS.
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Always buyers of all types polythene scrap and powders, cellulose acetate, p.v.c. and Perspex scrap. Wandex Plastics, 23 Pitfield St., N.1. Clerkenwell 8973. 199-24

Raw Material (contd.)

CLEAR ACETATE AND CELLOPHANE, sheets, rolls and offcuts, any quantities, urgently wanted.
Please offer with samples and particulars. Box P981, care of "Plastics." 198-17

POLYTHENE, natural, scrap, lumps, reground, film and virgin, wanted. Please send offers with samples to Herbert Sonnor, Ltd., 120 Beaufort Park, Falloden Way, London, N.W.11. 198-19

POLYSTYRENE, clear and coloured scrap and virgin surplus lots, continuously, in large quantities, required.
Please send detailed offer to Herbert Connor, Ltd., 120 Beaufort Park, Falloden Way, London, N.W.11. 198-18

SCRAP. Offer to:—
Michael S. Stevens, Keswick Works, Putney, S.W.15. Vandyke 3345. 198-3

CATALIN SURPLUS STOCKS rods ¾ in. to 1¼ in. required, all shapes, any quantity for own use, must be cheap. Box P897, care of "Plastics." 198-x3378

PROMPT CASH OFFERED for virgin and reprocessed cellulose acetate and polystyrene. Give manufacturer's name and packing. Box P873, care of "Plastics." zzz-464

P.V.C. GARMENT AND HANDBAG OFFCUTS wan.ed. We collect and pay cash. Brockwell Plastics, Ltd., 50 Hollingbourne Rd., S.E.24. zzz-463

CLEAR PERSPEX OFFCUTS wanted. 3/16-in. and ¼-in. minimum sizes 12-in. by ¾-in. ⅛-in. minimum size 2-in. by 2-in. Particulars to Box P9812, care of "Plastics." 198-x3314

REQUIRED IMMEDIATELY for export. Clean Perspex Scrap, any colour, any size, any quantity.
Write details available supplies to shippers. Box P989, care of "Plastics." 198-24

PERSPEX SCRAP required in any quantities. Contracts offered. Box P9813, care of "Plastics." 198-x3029

REPRESENTATION WANTED

LARGE MANUFACTURERS OF PLASTIC SHEETING with works outside London require representative in the London area with knowledge of the industry and experience in the supply of this material to the raincoat and fancy goods trade. First-class appointment for the man with the right qualifications. Own staff have been advised. Write, giving full particulars, to Box P9827, care of "Plastics." 198-33

SITUATIONS VACANT

The engagement of persons answering advertisements in respect of vacant situations must be made through a local office of the Ministry of Labour, or a schedu.ed employment agency, if the applicant is a man between the ages of 18 and 64 inclusive or a woman between the ages of 18 and 59 inclusive, unless he or she, or the employment, is excepted from the provisions of Notification of Vacancies Order, 1952.

THE ENGLISH ELECTRIC CO., LTD., LUTON, invite applications from engineers for experimental work on structural plastics for the guided weapon industry.
Duties will include design of components, preparation of drawings for rigs and equipment and supervision of laboratory personnel. A previous experience of plastics is not essential, but applicants must have a thorough engineering background and an imaginative approach to new and untried techniques and processes. Applications stating age, experience and qualifications, to Dept. C.P.S., 336-7 Strand, W.C.2, quoting Ref. 1086A. 198-13

SCIENTISTS, technicians or executives with a sense of social responsibility need not work on the race for rearmament; this well-established manufacturing business in synthetic resins, high polymers, etc., for paints, reinforced plastics and allied trades and based on common ownership and industrial democracy, is always on the look-out for trained men and women with faith in their fellow men and prepared to take an active part in the pioneering of a self-governing industrial enterprise. Write in confidence to The Managing Director, Scott Bader and Co., Ltd., Wollaston, Northamptonshire. Assets over £150,000. Our officially registered Commonwealth Foundation guarantees the security and well being of its members. 199-1035

PLASTIC ENGINEER required by large American plastics manufacturer, to supervise construction and testing of plastic moulds in Great Britain and Europe. Write, Box P982, care of "Plastics." 198-16

EXPERIENCED INSPECTOR required capable of taking charge of small staff. Must have knowledge of Plastic industry and previously held A.I.D. Stamp.
Full particulars in writing to Elco Plastics, Ltd., High Wycombe, Bucks. 198-6

AN ORGANIC CHEMIST is required for research work on synthetic resins. No previous experience in this field is necessary. Good beginning for man recently graduated.
Candidates should write, stating age, qualifications and particulars of past record, to Aero Research Limited, Duxford. 198-8

NATIONAL COLLEGE OF RUBBER TECHNOLOGY.
Northern Polytechnic, Holloway, London, N.7.
The Board of Governors invite applications for appointment as full-time Lecturers in Plastics Technology with experience of thermo-setting and thermoplastic polymers. Salary scale £990 x £25 x £1,090.
Form of application, together with full particulars, will be sent on receipt of a stamped, addressed foolscap envelope. R. H. Currell, Clerk. 198-11

A MATERIALS ENGINEER is required to guide the employment and manufacturing processes connected with the use of rubber, plastics and other new materials in aircraft ancillary equipment.
It is essential for candidates to be well qualified and have an intimate knowledge of up-to-date methods of using rubber.
This is a new appointment of considerable importance and the remuneration will be in keeping with the qualifications and experience of the successful candidate. Write Box P129, care of 191 Gresham House, E.C.2. 198-13

TOOL ESTIMATOR with sound experience in tool design and tool costing required for the Plastics Division of
Universal Metal Products, Ltd., Langley Rd., Salford 6, Lancs. Good prospects for the right man. 198-12

Situations Vacant (contd.)

LABORATORY TECHNICIAN capable of developing new ideas in connection with plastic products. Commencing salary £500-£750, dependent on qualifications and experience. All replies treated in strict confidence. Delmore, Ltd., 426-428 High Rd., Chiswick, W.4. 198-36

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Write brief description of past experience, age, family status, etc., and enclose small photo. or snapshot. Apply Box P9819, care of "Plastics." 198-29

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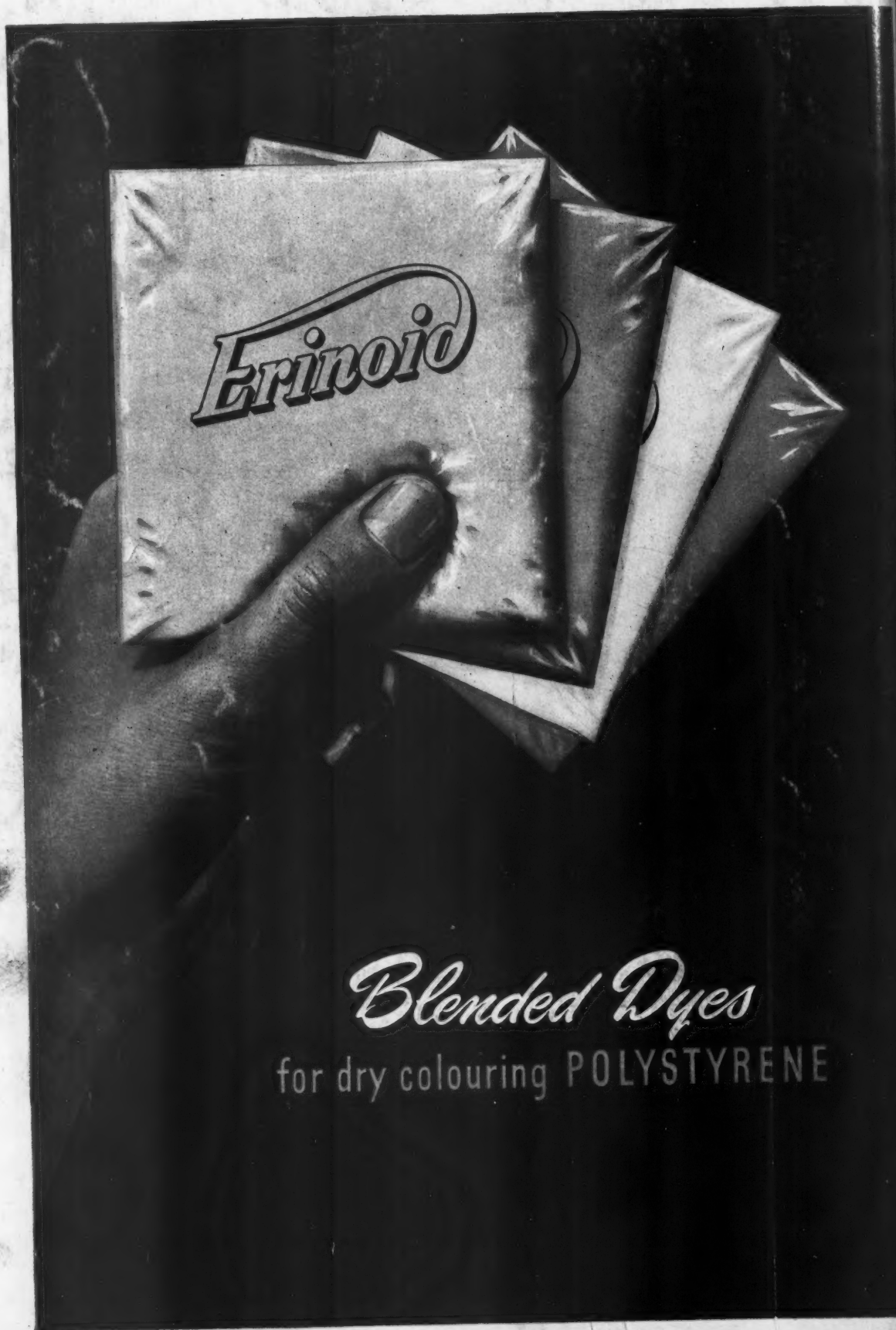

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